The Foundry Trade Journal

AND

PATTERN-MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

Vol. 9. MAY, 1907. No. 65.

—PUBLISHED—
THE FIRST WEEK IN EACH MONTH BY

EAGLAND & Co., Ltd.,
165, STRAND, LONDON, W.C.

Devoted to the interests and advancement of the Iron, Steel and Brass Foundry Trades.

Subscription Terms: 7s. 6d. per annum, post free.

To place the "Journal" within the reach of Working Moulders and Pattern-makers the Proprietors will accept subscriptions, not less than three in number from one shop, at the reduced rate of 5/- per annum, such order to be countersigned by the superintendent or foreman of the shop as a guarantee of good faith.

Any Subscriber having difficulty in obtaining copies promptly should notify the Publisher of the "Foundry Trade Journal," 165, Strand, London, W.C., giving the name of his local newsagent.

WE INVITE PRACTICAL ARTICLES ON THE TRADE IN ALL ITS BRANCHES, WHICH WILL BE PAID FOR. MSS. SHOULD BE WRITTEN ON ONE SIDE OF THE PAPER ONLY.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
165, Strand, London, W.C.

BRITISH FOUNDRYMEN'S ASSOCIATION.
LIST OF SECRETARIES.

General Secretary: F. W. Finch, Kingston House, Lansdown Road, Gloucester.
Manchester: C. Carson Bransby, 74, Winston Lane, Stretford.
Birmingham: F. J. Cook, 86, Milcote Road, Bearwood, Smethwick.
Cardiff: R. Griffiths, Messrs. J. Williams & Sons, Ltd., Globe Foundry, Cardiff.

TENSILE TESTING OF CAST IRON.*

By F. J. Cook.

At the present time I do not know a branch that allows so much scope for improvement, and at the same time a saving of money, as does the foundry.

I take it the sole object in including in a specification for machinery a clause dealing with the tensile strength of cast iron, is to insure that the castings made from that material shall be of the right strength for the safety and successful working of the parts. How far the usual specification attains this object is the first point I wish to discuss, and for this purpose let us consider the rules generally laid down for the carrying out of this test which is to prove whether the material is of the desired quality or not.

The particulars given by a firm which I believe are the largest buyers of machinery in the world, and who at least insist most on the terms of their specification being carried out to the letter, and whose terms I find are the ones used generally, read as follows:—"Test pieces are to be taken from such castings as may be considered necessary by the inspector. The minimum tensile strength is to be 9 tons per square inch taken on a length of not less than 2 in." This is the written law. The unwritten law is that bars shall be cast on the important castings of whatever size the founder thinks fit, providing they are not abnormally small; these are to be broken off the castings by the inspector, turned at the ends to suit the grips of the testing machine, and a part of the middle of the bar—not less than 2 in. long—to be turned down to give an area of $\frac{1}{2}$ square inch, or thereabouts, and tested in the presence of the inspector. Now this rule allows, and it is the general practice, that one size bar of about $1\frac{1}{4}$ in. to $1\frac{1}{2}$ in. diameter is cast, no matter what the dimensions

* Abstract of Paper read before the Birmingham Association of Mechanical Engineers, April 6, 1907.

of the castings are which it is to represent, and is the same and is accepted whether the casting is, say, a small cylinder for electric light engines, such as used on torpedo-boat destroyers, which has to be as light as possible and work with a steam pressure up to 300 lbs. per square inch, and whose thickness of metal is usually about $\frac{5}{16}$ in.; or a cylinder for a motor bus working with steam at 600 lbs. pressure superheated up to 800 degrees C.; or a petrol motor or gas engine cylinder, which may have to work with maximum pressures of 500 lbs. with gases at a temperature of 1,500 degrees C., or more. Or, on the other hand, say, for a huge cylinder, such as used on large marine work, weighing many tons, or a flywheel such as used on large engines for mill and electric lighting purposes, which may weigh—in one casting—up to 20 to 30 tons, and have a periphery speed as high as 110 ft. per second. These examples I have selected as they represent some of the extreme conditions under which cast iron is used in tension. Now, no one will deny that for each of the castings mentioned, which form vital parts in some of the most important engineering works of to-day, it is imperative that the quality of the metal from which they are made shall be the very best for their respective pieces, and I think also that it will be quite obvious, even to those who do not consider themselves metallurgists, that to cast the same size bar to represent each of the castings I have mentioned is far from being an ideal way of ascertaining the strength of the castings themselves.

It is a fact well known to metallurgists and foundrymen, that the physical properties of most cast metals, such as size of crystals, hardness, coarseness of grain, strength, etc., are greatly influenced by the rate of cooling from the molten to the solid state, and in none is this more clearly shown than with cast iron; in fact, with this metal it must be considered only second to none, and, in fact, in many cases of equal importance to the chemical composition of the metal itself, when considering it on the lines of its tensile strength. To prove this statement by ocular demonstratoin, I had cast a bar in the shape of a wedge, tapering from $\frac{1}{4}$ in. by 3 in. at one end, to 6 in. square at the other, by 2 ft. long. This was made on end, the thin end bottom in a dry sand mould, and cast from metal fairly low in silicon and total carbon, such as would give strong castings of $1\frac{1}{4}$ in. to 2 in. thick, and was left in the mould until properly cooled down. When the bar was broken, the fracture ranged from close-grained white iron at the thin end, to very open grain—with large crystals in the centre, giving very little cohesion—at the other, and with varying degrees of closeness in between.

To further demonstrate the difference in various parts of the bar, hardness tests were taken at 5 in. from the thin end, 3 in. from the thick, and half-way between these two points; this was done by noting the number of revolutions required to drill to the same depth at the various points, with the same weight acting on the point of the drill, and the result came out at 70, 56, and 40 respectively. The holes were drilled from the side of the casting into the centre, and clearly demonstrate the difference in hardness at the three points. Now, these differences in hardness and fracture show what is likely to happen in the various size castings I have mentioned if they were all cast from the same metal; in fact, if the thin castings were made from this mixture, the difference would be even greater than that shown, for, owing to the great amount of heat and slow cooling of the thick end of the wedge, the thin part has been slightly annealed, whereas in a thin casting this annealing effect would be absent and the rate of cooling more rapid, resulting in a chilled white iron, practically impossible to cut under ordinary commercial conditions, for such castings as cylinders. It is also quite possible for the differences to occur in the same casting if badly designed with abnormally thick and thin parts, and no doubt many can call to mind instances where these differences have been shown up either when machining—in the shape of very open grain and spongy places—or in cavities when testing them under hydraulic pressure.

Owing to the complex nature of cast iron, with its ever varying proportions of the various elements of which it is composed, it is impossible to lay down actual rules as to what the difference in tensile strength will be, but the following two series of experiments give an indication of the tendency in which the tensile strength is affected. The first series of bars were cast from iron to give average strength for medium-sized work, with close grain for good polishing surfaces, and with reasonable rate of machining, which necessitated it belonging to what may be termed the harder class of iron. The second series were cast from ordinary No. 3 soft foundry pig-iron, of fairly close and strong quality, and the results are shown below :—

Diam. of bars at cast	¼in.	½in.	1in.	1½in.	3in.
Tensile test of 1st series in tons per square inch	9.26	10.72	11.6	12.61	8.35
Tensile test of 2nd series in tons per square inch	13.2	12.6	11.9	11.1	7.0

from which it will be seen that the harder iron gave poor results for small castings, increased strength for larger, and weak for very large; whilst the soft iron gave strong small castings with decreasing strength as the size increased.

It is sometimes the practice for foundrymen to cast tensile bars in a separate mould, with iron taken from the ladle of metal from which the casting is to be made, which it is to represent; and there again the difference in rate of cooling is made manifest, although in this case casting temperature may also have some little effect, the bar generally being cast with hotter metal than that actually going into the casting. With bars cast in this way it is the usual practice for the middle part to be cast about 1 in. diameter, with the ends large enough for the machine grips, and from the results of a great many tests made in this way compared with bars parallel 1½ in. diameter cast on the castings themselves, I find there is a difference of about 16 per cent. higher tensile strength with hard irons, in favour of the bar cast separately. Mr. Buchanan also, some time ago, made experiments with bars cast on castings they were to represent, but with varying distances away from it, and others cast separately, from which he found that in every test he made the bar cast separately was the strongest, the bar cast on the casting, but farthest from it, less strong, and the bar cast in close proximity to the casting itself the weakest.

The usual method adopted by engineers to prove the tensile strength of the iron in castings is not effective. Under the present conditions prevailing in this country it is practically impossible to compare the figures for cast iron tests one finds quoted in papers read before societies, and in periodicals, unless all the information as to size of bar and mode of making same is fully stated, which is very rarely done. It therefore necessarily follows that without any standard to work to, the system at present in use is more or less in a chaotic state, but as we have a National Physical Research Laboratory subsidised by Government it is to be hoped that something will be done to lay down rules to govern this test, and form standards, when one can definitely compare the results they are obtaining in their own works.

In America a special committee, appointed by the American Foundrymen's Association, have gone into this matter, and after many experiments, etc., have formulated rules for making the test bars, and a standard which is to govern this test, and to which buyers and sellers are to agree to as a basis for comparison in cases of dispute.

Their proposal is that the quality of the iron going into castings under specification shall be determined by means of the "Arbitration bar"; this is a bar 1¼ in. diameter by 15 ft. long, which shall serve the purpose for both tensile and transverse tests. The bottom of the bar is $\frac{1}{32}$ in. less in diameter than the top, to allow for draft and for the strain in pouring. Two bars are to be cast in one mould, which is to be rammed up with green sand a little damper than usual, well mixed and put through a No. 8 sieve, with a mixture of 1 to 12 of bituminous facing; the mould to be rammed evenly and fairly hard, thoroughly dried, and not cast until cold. The test bars are not to be removed until cold enough to be handled. Two sets of bars to be cast from each heat; one set from the first, and the other from the last iron going into the castings. When the heat exceeds 20 tons, an additional set of two bars shall be cast for each 20 tons or fraction thereof above this amount. In case of a change of mixture during the heat, one set of two bars shall be cast for every mixture other than the regular one. Each set of two bars to be made in one mould. The bars shall not be rumbled, or otherwise treated, being simply brushed before testing. The bars are tested first transversely, upon which the Americans mostly rely, and the tensile test bar is made from one of the broken halves, turned down, which must give tensile test results of not less than—

18,000 lbs. per square inch for light castings.
21,000 ,, ,, ,, medium castings.
24,000 ,, ,, ,, heavy castings.

In dividing castings into light, medium, and heavy classes, the following standards have been adopted. Castings having any section less than ½ in. shall be known as light; castings in which no section is less than 2 in. thick shall be known as heavy; whilst medium castings are those coming between these two classifications. Although we may not agree with everything they may recommend, yet I think they are entitled to much credit for the definite way in which

the rules have been framed, and for having been the first to face what is a most difficult problem. Since this work was done, specifications have been completed by the same committee for cast-iron pipes, cast-iron car-wheels, malleable castings, locomotive cylinders, and foundry pig-irons, all of which have been dealt with on similar definite lines to the one I have quoted.

Owing to the inferior ductility of cast iron, compared with mild steel or wrought iron, it is not practicable to use a bar of uniform section—such as is the case with tests of these metals—as it would, in most cases, fracture at the point where the machine gripped the specimen, and give too low a value for its tensile strength. In consequence of this, there are several types of bars in general use. In all bars it is essential that the corners be rounded and changes of section made as gradual as possible, especially at the point where the head joins the neck, or it will be liable to break there and spoil the test. This is of the greatest importance if the bar be cast to the outline of the finished specimen, owing to the fact that in a casting made with sharp corners, the crystals arranging themselves at right angles to the cooling surface form lines of weakness at these parts. It is also essential, in the finished bar, that this radius shall be of such dimensions that the grips do not bear on it, but allow the head to be flat, otherwise the head will in all probability be broken off.

There are several types of machines for tensile testing of metals. These machines are generally made in two sizes, having ranges of 50 and 100 tons respectively. Although no rules and regulations have been set down for the mode of making test bars, yet it is interesting to know that the Board of Trade have regulations governing the design of the testing machine, which are generally known as follows :—

"The total leverage of a testing machine not exceeding 100 tons capacity, shall not be more than 100 to 1."

"The distance between any two knife-edges shall not exceed 4 in., and the length of knife-edge shall be so proportioned that 1 in. of length shall not be required to withstand more than five tons strain."

"The poise weight must indicate up to the full capacity of the machine, without the use of loose proportional weights."

So far we have dealt with this subject from the engineer's point of view, with the exception of that part respecting the rate of cooling. We will now consider the points that go to give good results in the foundry for this test and for the castings they are to represent.

Next in importance to the rate of cooling comes the action of the various metalloids on cast iron, and here I may be allowed to reiterate a previous statement—that owing to the complex nature of cast iron, and other conditions that have to reckoned with in casting and cooling, etc., no definite rule as to analysis can be laid down that will insure any certain result. Many devoted workers are still investigating the effects of the different elements on cast iron and on one another.

For many years past the question of what is the best temperature of iron at which to pour castings has been a most debatable point with foundrymen, but it has been considered mostly as to its influence on the production of clean, sound castings than in the direction of its effects upon strength. For some time now several members of the foundry trade have made investigations as to the best temperature to produce the strongest castings, and many series of experiments have been made, including some by the author, the method usually adopted being to cast several test bars from the same ladle of metal, the first being poured with the iron as hot as can be obtained, the remainder with certain intervals of time between, and it has generally been found that the bars cast as hot as possible have given the best results.

Although this has proved very useful to many, yet at best it is very indefinite, as, owing to the difference of working in various foundries, what is considered hot metal with one may be considered but of medium heat with another. We are, therefore, indebted to Mr. Percy Longmuir, of Sheffield, for the investigations he has made in this direction, and which clearly show the importance of casting temperature.

One of the chief troubles with motor cars at the present time is due to the cylinders wearing badly. This is not to be greatly wondered at when one considers the high temperature of the gases with which they have to deal, and that the design, which has to be as light as possible for obvious reasons, necessitates a soft iron with high phosphorus being used to insure that the castings will run properly, and not be too hard for machining purposes. This class of iron is naturally weak, and is often the cause of the cracks where the water jacket

joins the cylinder, and to obtain castings that can be tooled readily in too many instances metal is used which is altogether unsuitable for such work as cylinders.

To give the best wearing qualities the iron should be very close grained, and to get this with motor cylinders as usually made would necessitate using an iron that would be extremely difficult to machine. It can, however, be brought about by the judicious use of chills in the bore of the cylinders, which greatly improves their wearing qualities without making them too difficult to tool, and I believe that this method will have to be more generally adopted before the difficulty is overcome. As by this method the grain is closed, it must also have a beneficial effect on the tensile strength of the castings. To show in some measure to what extent this may be, the author cast two sets of bars from the same class of metals as that used in the experiments on different diameter bars, previously mentioned in this paper. The bars were all of the same diameter, and were cast with chills $\frac{3}{8}$, $\frac{1}{4}$, and $\frac{1}{8}$ thick. The results are given in the following table :—

Analysis.						Thickness of chill.	Maximum stress in tons per sq. in.	Per cent. gain.
C. C.	Gr.	Si.	Mn.	S.	P.			
2.31	2.804	1.96	0 5	0.11	1.1	0in.	11.6	
,,	,,	,,	,,	,,	,,	$\frac{1}{8}$in.	15.15	
,,	,,	,,	,,	,,	,,	$\frac{1}{4}$in.	15.6	30.6
,,	,,	,,	,,	,,	,,	$\frac{3}{8}$in.	white iron.	34.4
trace	3.57	0.35	0.28	0.01	1.5	0 n.	8.1	
,,	,,	,,	,,	,,	,,	$\frac{1}{8}$in.	11.9	46.9
,,	,,	,,	,,	,,	,,	$\frac{1}{4}$in.	12.3	51.8
,,	,,	,,	,,	,,	,,	$\frac{3}{8}$in.	15.2 soft iron.	87.6

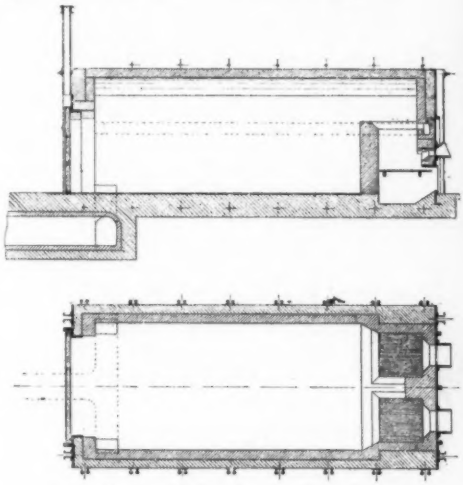
It will be seen that a good iron was improved by 30.6 per cent. by using a chill $\frac{1}{8}$ in. thick, and 34.4 per cent. by using one $\frac{1}{4}$ in. thick, whilst with a $\frac{3}{8}$ in. drill the bar was turned into white iron. The results with the soft iron are more remarkable still, as $\frac{1}{8}$ in. chill improved the strength by 46.9 per cent., $\frac{1}{4}$ in. chill by 51.8 per cent., and $\frac{3}{8}$ in. chill by 87.6 per cent.

——o——

JOSEPH BREEDEN & COMPANY, LIMITED, Birmingham, have removed their London office to College Hill Chambers, Cloak Lane, Cannon Street.

DRYING AND ANNEALING FURNACES FOR STEEL FOUNDRIES.*

WHILST the improvements in the construction of melting furnaces, gas producers and boiler furnaces have reduced the consumption of fuel to the lowest limit, there still remains a good deal to be done in connection with the furnaces for drying the moulds and annealing the castings; and that this is feasible will be shown in the following, although no exact figures can be given, the total consumption



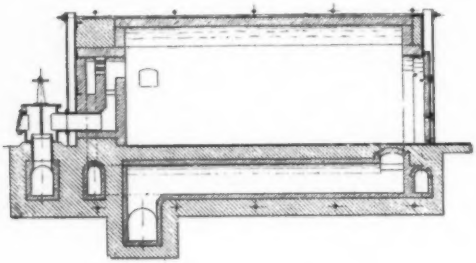
FIGS. 1 AND 2.

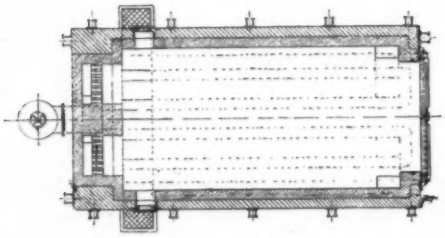
depending on the time the furnaces are kept at work.

Figs. 1 and 2 illustrate a drying furnace with flat grates ($1\frac{1}{2}$ in. square bars) arranged at one end and separated from the bed of the furnace by a high fire bridge. The products of combustion escape at the further end through apertures on the bed level, and the draught is regulated by dampers in the flue. The moulds to be dried are wheeled in on trucks, through the door at the far end, on to the cast iron plates forming the sole. The fuel is placed in the hoppers shown covering the fire doors, and covers the grate to a depth of 8 in. to 16 in. The amount of air drawn in by the chimney draught should be two to three times as much as is theoretically necessary for the combustion of the fuel, so that the volume of gases is very large,

* H. Gille, "Giesserei Zeitung."

and a corresponding amount of heat is wasted. Since the high temperature in the grate rapidly gasifies the fuel, the oxygen present in the indrawn air is insufficient to produce perfect combustion of the products, and consequently a secondary supply of heated air should be introduced above the coal, but only during the gasification period. This, however, is impracticable, for various reasons, and a constant supply must be resorted to, the air being warmed in flues made in the side walls of the furnace. Owing to the small draught the firebars have to be set rather wide apart, resulting in a loss of coal; and besides, the dust from the fire settles on the moulds and burns on to the surface, thus producing rough castings.





FIGS. 3 AND 4.

An improved form of drying furnace is shown in Figs. 3, 4, and 5. The sole is like that of the other furnace, but the moulds are introduced through double doors, which are held tightly against the frame by means of iron girders, the bottom slit being closed by a heap of sand. The exhaust for the furnace gases communicates with two flues that run back under the sole of the furnace on their way to the chimney stack. Generator gas is used for heating, being introduced from a brick main into the two mixing chambers. The air for combustion is warmed by being passed first through a pair of flues on the outside of the exhaust flues (Fig. 5), and then flowing back through a central flue, which delivers it into two shafts that lead to the mixing chambers through checkerwork passages. By this means the mixing of the gas and air is effected in a manner that ensures combustion, being extended over a larger area of the furnace, and produces a more satisfactory drying effect. To secure perfect combustion the air supply must be 30 to 50 per cent. in excess of theoretical requirements. This arrangement is superior to the former one, but the effect could be further improved by the addition of a recuperator for heating the air of combustion. There is no dust, and the small

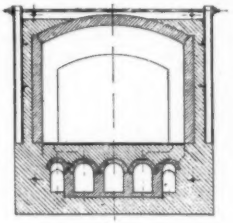
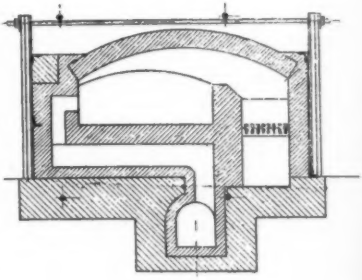
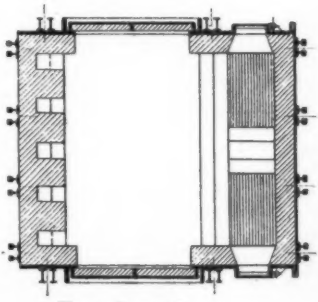


FIG. 5.



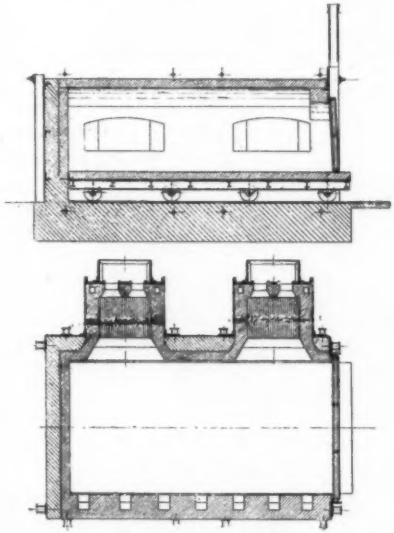


FIGS. 6 AND 7.

amount of soot deposited on the moulds when the gas is rich in hydrocarbons, either burns away or can easily be dusted off.

Figs. 6 and 7 illustrate a small heating furnace with fixed hearth at the side, the castings being introduced at one end and taken out at the other. The grate is similar to that of a steam boiler, with dished cast iron bars, carrying a layer of fuel about 8 in. deep. The roof is arched, and the products of combustion pass through the heating chamber and into flues under the sole. This method has the same defects as the first drying furnace mentioned, but the loss of heat is greater, the gases escaping at a higher temperature.

A larger furnace with flat grate and movable sole is shown in Figs. 8, 9, and 10. The two grates are placed at one side, and are arranged independently of



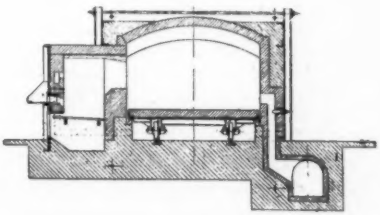
FIGS. 8, 9 AND 10

the heating chamber, the products of combustion entering the latter through two large apertures, and passing away through a number of smaller holes on the opposite side into the flue leading to the stack. This lateral disposition of the grates is only advisable for large furnaces, end grates being preferable for smaller sizes. The exhaust openings can be closed with fireclay dampers, to secure uniform heating. The movable sole or truck is made of a framework of section iron faced with sheet iron, which in turn is covered with a layer of firebrick. The wheels are keyed on short axles running in simple bearings and lubricated with graphite. The space between the sides of the truck and the walls of the furnace is packed by means of sand contained in a trough into which dip angle iron flanges at the edges of the truck. The secondary air is heated by passing under the truck, the frame and wheels of which are thereby cooled. The truck is moved by a crane or winch and endless chains, and the furnace door, when lowered, rests on the surface of the truck, thus making a tight joint.

——o——

THE "LEEDS" PORTABLE MOULD DRYING STOVE.

A HANDY stove for drying moulds with hot blast on the foundry floor is now



making its appearance amongst the trade, and is known as the "Leeds" Portable Mould Drying Stove.

It will be found very valuable in those foundries making castings from a few hundredweights upwards; and to mention actual cases, it has been successfully used on marine engine bases, crank discs, condensers, cylinders, propellers, pumps, etc.

The stove being provided with a horizontal as well as a vertical downward delivery, is placed at the end opening of a condenser or cylinder mould, as shown in the accompanying illustration (Fig. 1), for a few hours, the moulds being made and black washed as if for ordinary stoving.

In the case of propellers, the joint of the mould is set up half an inch, and the stove is placed over the print opening at the top of the mould, as shown in the second illustration (Fig. 2), the reversing valve in the delivery pipe being thrown over to open the downward delivery and close the horizontal.

Where the drag only needs drying, the stove may be slung on a hoist by the bail provided, or placed on bars above the open mould, the remaining part of the mould being covered with sheet iron.

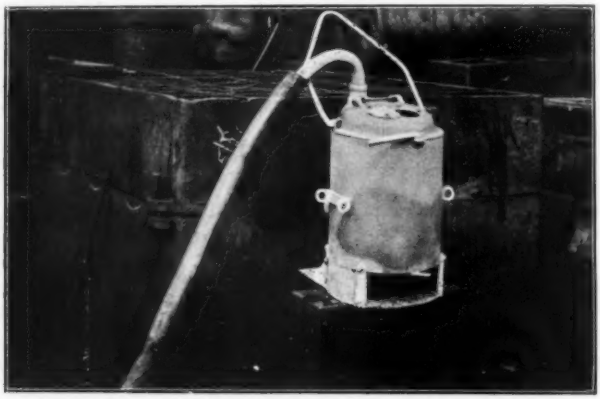


FIG. 1.

A regulator is provided on the top of the mould drier, whereby the temperature and volume of the hot gases may be considerably varied according to requirements and existing conditions of blast pressure.

The temperature for an ordinary sand mould must not greatly exceed 600 degrees F., while for steel moulds a higher temperature may be used.

As sent out, the stoves are provided with a blast nozzle to suit the lowest blast pressures generally met with in foundries, *i.e.*, 4 to 6 ozs., whilst the highest pressures in smaller volume can be connected with equally good results.

FIG. 2.

Where high pressures are in use, smaller flexible pipes can be used than where the lower pressures are the rule, but for the latter the pipes should not be less than 2 in. internal diameter.

As a practical foundryman, the inventor does not put forward any absurd claim of drying large moulds in a few minutes, knowing, as other practical foundrymen know, that to dry a mould from, say 1 in. to 4 in. in it without injuring the same, a reasonable amount of time must be allowed, and from one to eight hours will generally be found necessary.

Propellers from 5 ft. to 7 ft. diameter are sufficiently dried in about two or three hours, while a repetition job of combination gears, which from the runner basin to the teeth are 2 ft. 9 in. deep, are allowed from twenty to thirty minutes each.

The stove being of the open ashpit type, with an induced draught, the fire can be made up at any time without in any way interfering with the blast pipe, on which no valves are necessary. The whole is of the simplest possible construction, and although weighing (when charged with 20 lbs. of coke) only 2 cwts., the stove is substantially built, and very economical in use.

The time and coke saved over the old plans of either kettles or ovens soon pays the small first cost, and afterwards the stove proves to be a continual source of profit. As the combustion is so perfect, no fumes are noticeable in the foundry when the stove is in use. Its extreme portability allows it to be placed on the mould by two men easily, and the blast nozzle being made to swing round either way for the flexible pipe connection, it can be placed in any position and put to work in two or three minutes, and only requires attention about once every hour or two afterwards.

To damp the fire the blast is simply disconnected, and combustion ceases almost immediately, and when the stove is finished with, the grate, which is hinged, can be dropped, thus saving the unburnt coke. The stove requires no more floor space than 21 in. by 15 in., and the ganister linings are found to last for a considerable time; being circular, the lining can be re-made by a labourer in half an hour. This stove is being placed on the market by Messrs. Horace P. Marshall & Company, Leeds.

—o—

CLAIMS against the business of W. A. Baker & Company, Limited, Central Engineering Works, Newport, are to be forwarded by May 21 to Mr. R. F. W. Fincham, 3, Warwick Court, Holborn, London, the liquidator.

FLUXES AND ALLOYS.*

BY ALEXANDER E. OUTERBRIDGE, JR.

BEFORE proceeding to consider the subject of fluxes it should be clearly understood that the discussion will necessarily be limited to the study of their function in the cupola, and of their effect upon the melting and properties of pig-iron when thus melted. The same limitations will apply to the study of alloys, for the subject is far too extensive to permit of more general treatment in one brief thesis.

The action of fluxes in a blast furnace, where iron oxide (ore), mixed with gangue, is reduced to the metallic state, is essentially different in many respects from the action of fluxes in a cupola, where the reactions in a blast furnace do not take place. So also the action of fluxes in a reverberatory furnace or in any open-hearth steel furnace is different from that in a cupola or in a blast furnace. Likewise the action of fluxes on steel or other metal melted in crucibles is dissimilar from that of the other metallurgical operations here named.

In blast-furnace operation, as well as in reverberatory furnace melting, or in open-hearth and crucible melting, fluxes set up important chemical reactions, such as separating the non-metallic elements from the metallic elements, or in refining metals by eliminating impurities; while in melting pig-iron in a cupola there is but little opportunity, even if the desire exists on the part of the melter, to change the character of the iron greatly by eliminating impurities. In the first place, there is not sufficient time, and in the second place the temperature at which melting is conducted in cold-blast cupolas is not sufficiently high to enable considerable changes in composition to occur. It is, first and last, a simple melting operation, and the fewer the changes in composition of the metal the better. Certain minor changes do occur in spite of all precautions; for example, sulphur in the coke used for melting has a strong affinity for the molten pig-iron when dropping like rain through the glowing mass of fuel; lime also has a strong affinity for sulphur, and it is a prevailing opinion that a lime flux is beneficial in cupola melting for this reason.

Lime is, undoubtedly, beneficial as a flux under most, if not all, circumstances in melting in a cupola, but whether its

* Paper read before the Pittsburg Foundrymen's Association.

advantage is due to the cause named, except in slight degree, is, I think, an open question.

Other changes undoubtedly occur, such as the burning out of some silicon and some carbon when melting pig-iron in a cupola. Still another change occurs, of more or less consequence, depending upon the character of the iron melted and upon the blast pressure, namely: the relative proportion of free carbon or graphite and of combined carbon (iron carbide) may be altered sufficiently to radically change the physical properties of the metal, even though the total carbon remains practically unchanged.

A Change that Evades the Chemist.

Last, I am convinced and have maintained for many years, that a serious change is produced that evades the chemist, and is, therefore, not revealed in analyses, which may, and probably does, have more influence on the product than any or all of the other changes combined. I allude to the dissolving in the iron melted in a cupola of a small amount of iron oxide, the oxidation of the molten iron taking place as it is dropping through the oxidising zone near the tuyeres. This dissolved iron oxide is, in my judgment, a weakening element.

Fluxing iron in a cupola has, as I have stated, but little effect upon these changes; they are inherent in the method of melting.

What, then, is the true function of fluxing of a cupola? My reply is that fluxing with limestone, oyster shells, fluorspar, etc., is useful mainly for the purpose of making a more fluid slag, thus preventing the slag formed from the non-metallic substances, such as ash, sand, scoria, iron oxide, etc., from clogging the cupola when the bottom is dropped, or from becoming mechanically caught in the stream of molten iron as it escapes from the spout. If you have a thick, pasty slag, you are apt to have dull iron and dirty castings.

Fluorspar, regarding which there has been some acrimonious discussion in the technical papers, makes an extremely fluid slag, and is therein beneficial, but unfortunately it also has a destructive action on ordinary cupola linings, and should be used cautiously on this account. The claim that fluorspar imparts any other beneficial influence on the molten iron lacks confirmation from analyses, and is suggestive in its vagueness of the ancient claims of the foundry doctors, already alluded to, who passed away nearly a generation ago.

There does not appear to be any established rule or custom among foundrymen regarding the proper quantity of flux, or the best method of changing it in the cupola in order to obtain economically the best results; the proportion of flux to iron melted varies all the way from 1 to 20 to 1 to 60 or over. Sometimes the flux is placed on the bed of coal, sometimes on top of the iron charges, sometimes it is used only at the beginning, sometimes only at the end of the heat, and more often, perhaps, with every charge of iron. Where such wide latitude in method exists in practice it is fair to infer that the use or non-use of fluxes in melting pig-iron in a cupola has but little effect upon the character of the iron—*i.e.*, upon its component elements.

In my own practice, extending over about 30 years, I have tried all of these methods, and a great variety of fluxes, while for some time past I have been using no flux of any kind in the cupola. It is proper to explain in this connection, however, that in this case no coke is used, the melting in the cupolas being effected with anthracite coal, as economically at present prices as with coke, and with distinct advantages over coke with respect to the smaller amount of sulphur absorbed by the iron, the lesser quantity of slag formed, the greater length of time the metal will remain fluid after tapping, etc. The slag formed, when melting with anthracite, is so small in quantity that it is not tapped from the slag-hole provided for the purpose and the space between the tuyeres and the lining of the bottom of the cupola is much less than is necessary when coke is used as fuel.

Whenever the ratio between cost of coke and anthracite has been in times past in favour of coke, I have used that fuel, either with anthracite or alone, as the case may have required; but, all other things being equal, I prefer anthracite to coke for melting pig-iron in a cupola.

To sum up in a few words, it may be readily inferred from the foregoing statements that I do not rely upon fluxing to improve the quality of the iron melted in a cupola, except in a very limited degree, but that I do recognise the advantage accruing from the moderate use of fluxes, especially when coke is the fuel employed, in order to increase the limpidity or fluidity of the slag, thus to assist the passage of the air blast through the burden, and finally to insure a clean drop when the melting is over.

Alloys.

If we could control accurately the melting of pig-iron in a cupola it would be a comparatively simple matter to charge the furnace with different grades of iron, like layer cake, and draw off the different layers as desired for the castings. This method is, in point of fact, followed to-day with more or less success, so that it is customary in some establishments to tap at least three different grades of iron from one cupola in one heat every day, care being taken to pour the castings according to a pre-arranged order. These may vary from little pulleys with rims less than ¼-in. thick in some cases, up to anvil blocks, bedplates for heavy machinery, etc., weighing many tons.

The Size of Test Pieces should always be stated.

For reasons herein given, I have heretofore maintained that tensile strength records of cast iron, as given in technical books and magazines, have no meaning or value unless we know the size of the test pieces; a difference of ¼ in. in diameter of two round tensile test bars cast from the same ladle of iron may make a difference of as much as 5,000 lbs. per square inch in the record of tensile strength. Moreover, with one kind or grade of iron the larger bar may be always the weaker, while with another kind of iron the smaller bar may always be the weaker of the two. I have many records of such tests to substantiate these surprising statements.

These facts surely suffice to prove that in cast iron we have an alloy of highly complex nature. It is a melange of half a dozen well-known elements and not infrequently contains a trace of one or more comparatively rare metals, all of which exert an influence upon the properties of the alloy. Thus, a small amount of titanium hardens cast iron, while tungsten, strange to say, seems to have an opposite influence. It is frequently asserted that a trace of copper renders cast iron very brittle. Yet I have alloyed copper with cast iron in various amounts from one-tenth of 1 per cent. to 1 per cent. and have failed to discover this tendency. It certainly closes the grain.

The Ordinary Constituents of Cast Iron.

You are all no doubt familiar with the ordinary constituents of cast iron, and even a brief discussion of their effects upon the metal would be too elementary for this audience. I will, therefore, only pause for a moment to point out one or two common errors that are continually being perpetuated in new text books.

Thus, for example, manganese is, I believe, invariably stated to be a hardening element in cast iron. This is misleading.

Manganese has been universally maligned as a hardening element in cast iron, the authors of such statements failing to realise that it performs two distinct functions: one as a hardening element, if in excess; the other as a softener of high chilling iron when that element is otherwise deficient in quantity. In one case the manganese acts *per se* as a hardening constituent, in the other instance its function is that of a deoxidising and desulphurising flux, exerting thereby a softening effect upon the metal. I may say, furthermore, that if the founder allows the proportion of manganese to fall too low—say, below 0.3 per cent.—he is certain to have complaints of hard castings.

The Great Softener.

Silicon is the great softener of all kinds of cast iron, and is usually added in the cupola in the form of "silvery grey pig," which may contain anywhere from 4 to 10 per cent. of silicon. Sometimes alloys containing even more silicon are added with pig-iron in the cupola, for the purpose of enabling the mixture to carry a larger proportion of scrap than would otherwise be prudent. Silicon charged into the cupola softens the metal, but also always reduces its strength.

I have announced on several occasions during the past two years, and published in various papers, the interesting and, I believe, valuable discovery that when an alloy of iron and silicon is added to ladles of molten iron, in the form of high-grade ferro-silicon (containing about 50 per cent. of the latter metal), it not only softens but at the same time strengthens the iron, thus reversing the universal experience that when you soften iron you reduce its strength.

The gain in strength varies with the kind of iron and the proportion of ferro-silicon added to the ladle. In some of my tests I have found an increase of over 25 per cent. in strength, with a decrease of hardness that is quite remarkable. These tests are easily made in any foundry where transverse test bars are cast and broken.

Another interesting and important feature of this method of manipulation is that by varying the amount of powdered material added to the ladle the proportion of silicon can be changed to

suit the requirements of any individual casting or any group of castings. As I have already described these experiments in detail in papers that have been published, I presume they are familiar to you all, and I will, therefore, refrain from going into further details at the present time regarding them.

—o—

VARIABLE - DELIVERY CONSTANT - STROKE THREE - THROW PUMP.

The demand for a three-throw pump with an economically obtained variable delivery, has for some time been a growing one, and so far has only been met by arrangements for varying the length of the actual stroke made by the plungers; these arrangements have necessitated the transmission of power through more or less complicated gearing, and have been open to the practical objection that when working on a short stroke, ridges form on the plungers, which, when the stroke is lengthened, are apt to damage the packing and destroy the efficiency of the pump.

Messrs. Thwaites Brothers, Limited, of Bradford, have, in conjunction with Mr. T. H. C. Homersham, recently taken out a patent for and perfected a pump in which the results aimed at have been attained in what is claimed to be a perfectly original manner, and one which is free from the above-named objections. In this pump the desired result is obtained by driving a small cam shaft direct from the crank shaft, the cams on the shaft being arranged beneath the suction valve stems. When pumping full bore, these cams merely follow the rise and fall of the suction valves, but as the relative angularities of the cams and the crank pins can be altered whilst the pump is running, by merely moving a small hand lever, the discharge can be varied from nothing to full bore. By this lever the relative angularities of the cams and crank pins being altered, the suction valves can be held open during the whole or any required portion of the delivery stroke of each plunger.

It is, of course, obvious that during that portion of the stroke when the suction valve is mechanically held open, no power is exerted beyond that necessary to circulate the water through the pump itself at no pressure, and that a perfectly even torque is obtained whatever delivery the pump is set for.

In practice the arrangement works most successfully, and when driven by an electric motor the amount of current used is found to vary exactly with the position of the lever regulating the cam shaft, and consequently the delivery of the pump.

We hope later to give a detailed and illustrated description of this pump.

—o—

BRITISH FOUNDRYMEN'S ASSOCIATION.

The Birmingham Branch.

The Birmingham Branch of the British Foundrymen's Association held their first annual general meeting and smoking concert at the Acorn Hotel, Birmingham, on Saturday, the 20th ult. There was a large attendance, presided over by Mr. R. Buchanan, the local President.

The Chairman congratulated the members on the excellent programme they had had during the session. The proceedings had been marked by great verve and spirit, and it was evident they were doing a distinctive and laudable educative work. There was no one for whom they felt a greater pity than the incapable workman who wished to do his best, but was unable to attain to the perfection he desired. In the same category was the foreman, or manager, dissatisfied with the degree of perfection obtained. They all recognised their imperfections, but when a man was in charge of others, and knew his serious deficiencies in knowledge, he felt less confident than he should be, and his usefulness was reduced. The knowledge of one's business was a great promoter of peace of mind, and if a man could apply his practical knowledge and scientific skill to his work, and be pretty certain what the result of his plans would be, that self-confidence, grounded on knowledge, helped to produce the success desired. The Association had come into existence to help the ambitious man who desired to attain the highest standard in his business and to make them all better workmen, foremen, and managers. They owed also a duty to their country, and they desired Great Britain to be a still greater workshop than ever, and to be at the forefront of the industrial world. They meant the foundry trade to advance, and they would not be satisfied with merely the second place. While it was true that the technical school got the brightest of the lads, it was equally true that their Association secured the

brightest foremen and managers. The aspirant who had a proper pride in his business would put himself in the way of acquiring all the knowledge he could lay his hands upon. Personally, he had never apologised for being a foundryman, and people who thought there was nothing in the trade only showed their ignorance. The farther they attained in knowledge, the more they were impressed with the necessity of studying the inner workings of their business. (Applause.)

Mr. F. J. Cook reported a balance in hand on the year of £2 4s. 11d.

On the proposition of Mr. Wilkinson, seconded by Mr. Baugh, thanks were tendered to the officers, and the Chairman, replying, said their work had been a labour of love.

Mr. Heggi proposed the re-election of the President (Mr. Buchanan) which was seconded by Mr. F. J. Cook, who said that a great deal of the success attained was due to their President. The proposal was carried with acclamation.

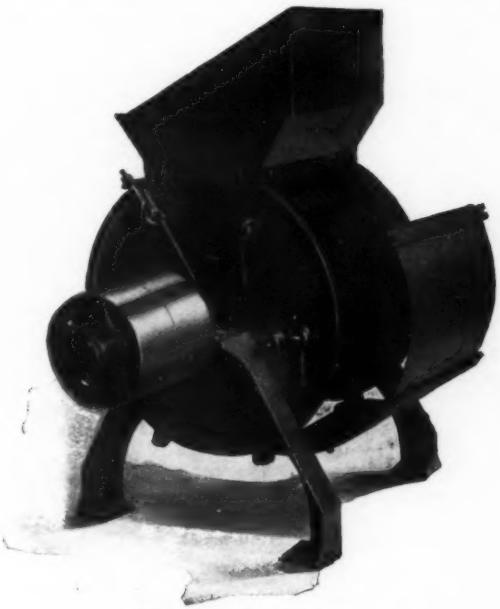
Mr. Cook having regretted his inability to retain the office of Secretary, Mr. Heggi was elected to this position, and Messrs. Mason, E. B. Crump, and F. J. Cook were chosen members of the Council.

The Chairman proposed a vote of thanks to the Press, acknowledging the great attention they had received from the local and trade papers, the compliment being briefly acknowledged by Mr. J. Horton, on behalf of the Foundry Trade Journal.

—o—

NEW SAND PULVERISER.

The disintegrator and sand pulverizer, illustrated in the annexed cut, is designed to pulverise lumpy sand and old cores, which operation it effects very thoroughly. By the use of this machine waste of lumpy sand and old cores in screening is avoided. The machine is made specially strong to stand hard usage.



New Sand Pulveriser.

If necessary, it can be opened out for cleaning, as shown in the illustration. A sample machine will shortly be on show at the Manchester warehouse of Messrs. J. W. Jackman & Company, Limited, 347, Chester Road, Cornbrook, Manchester.

—o—

Messrs. C. J. Utley and T. Stanley, engineers, Leicester, trading under the style of C. J. Utley & Company, have dissolved partnership.

REPAIRING LARGE CASTINGS WITH "THERMIT."

THE welding compound known as "Thermit" has now been before the foundry trades for some time past, and is extensively used in many directions. Its use for the purpose of repairing large castings, the renewal of which is often attended with great difficulties, is nowadays being more generally recognised, and a demonstration—which was recently given by Thermit, Limited, of 27, Martins Lane, E.C., who control the English rights for the alumino-thermic process—at the Thames Iron Works and Shipbuilding Company's Dry Dock Department, should go far to remove any prejudices which may exist against its use. A large company assembled to witness the test, amongst those present being :—

Messrs. W. C. Thomas (Admiralty, Whitehall), M. Fitzmaurice (London County Council), H. J. Cornish (Lloyd's Register), W. Seaton (Board of Trade), H. Withy (Furness, Withy & Company), J. B. Kidston (British Corporation for the Survey and Registry of Shipping), Harland & Wolff, W. F. Pettigrew (The Furness Railway), J. T. Milton (Lloyd's Register), Captain Wingfield (India Office), Messrs. T. Mitchell (H.M. Dockyard, Portsmouth), A. Mackinnon (Livesey, Son & Henderson), G. T. Henderson (Lloyd's Committee), Andrew Young (Bureau Veritas), Sir Wm. White, K.C.B., Mr. Bate (H.M. Dockyard, Chatham), Mr. J. H. Whiting (Agent General for South Australia), Major H. Barlow (Royal Laboratory, Woolwich), Messrs. G. Shaw (North-Eastern Railway), Maurice S. Gibb (Central Marine Engine Works), and many others.

The process is fairly well known, but it may again be mentioned that the ingredients of Thermit are nothing but finely divided aluminium and iron oxide, intimately mixed. This mixture, placed in a suitable crucible and ignited on the spot by means of a special ignition powder, burns down completely in a very short space of time, and in so doing separates itself into aluminium oxide in the form of slag and a pure quality of iron, which has the composition of mild steel.

The demonstration consisted of (1) the repair in two places of a forged steel stern frame which was erected as if in position on a ship; (2) the welding together of two pieces of cast steel, each 5 ft. long of "U" section, shown in Fig. 3.

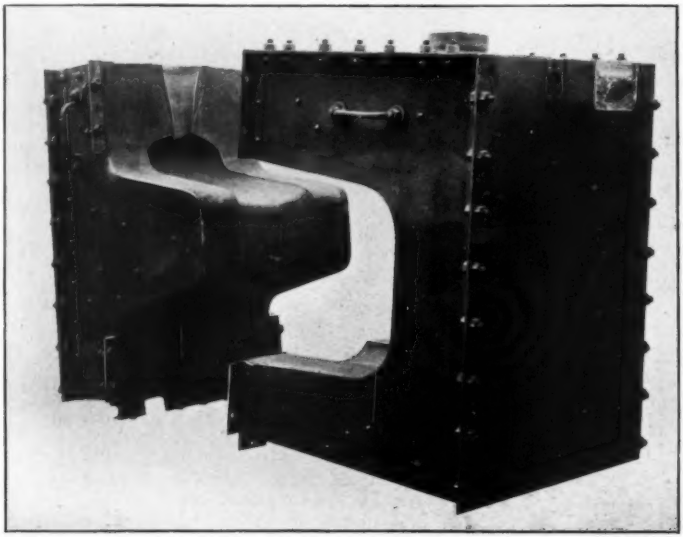


FIG. 1.—MOULD FOR "U SECTION.

The overall dimensions of the stern frame were 32 ft. by 14 ft., and the weight about 9 tons. The repair was made on the lower horizontal post, section 10⅜ in. by 7 in.

In both cases the fractures were opened out to 1¼ in. in order to allow the Thermit iron to flow in between as well as around the two ends to be welded. A sand mould in two parts was then placed around the fracture and the two ends to be welded were brought to a red

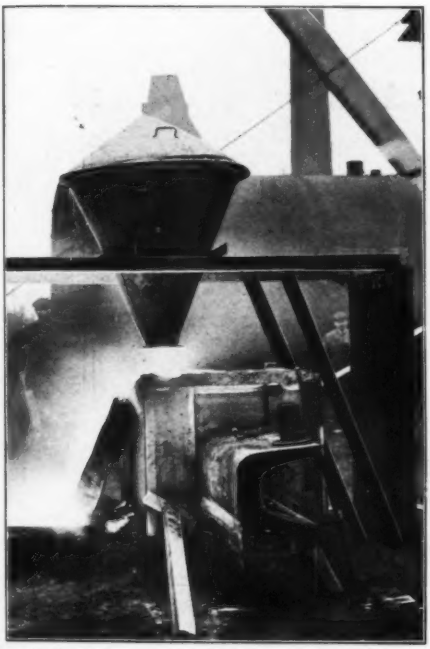


FIG. 2.—"U" SECTION; THE RUN.

heat. This was accomplished by means of a pre-heating stove which was filled with coke and connected by means of a pipe with the riser of the mould. Compressed air for the stove was supplied by an ordinary standard pattern Sturtevant blower, giving a pressure of about 5 in. of water at 3,200 r.p.m. The hot gases from the stove were forced through the mould, and escaped by means of the runner. The heat so obtained not only heated the parts to be welded, but also the moulds, which would otherwise cool down the Thermit iron to too great an extent before it reached the bottom of the mould.

Whilst this operation was being carried out, the crucible was placed in position and filled with the Thermit compound, in both instances about 4 cwts., with which was mixed a quantity of iron punchings and about 1 per cent. of manganese. As soon as the pieces to be welded were brought to the desired temperature the compound was ignited. The reaction occupied about one minute, when the crucible was tapped, and the Thermit iron, at a temperature of between 4,000 degrees and 5,000 degrees F., flowed into the mould.

In about four hours the metal had cooled down sufficiently to enable the moulds to be removed, and the welded portion then underwent an annealing process over a charcoal fire.

The "U" section castings were welded in a similar manner, but the quantity of compound used in this instance was 8 cwts., with which was mixed a quantity of iron punchings and a small percentage of manganese. Fig. 1 shows the mould which was used for the "U" section. Fig. 2 shows the repairing operation, while Fig. 3 shows the "U" frame after completion. It may be mentioned that Thermit, Limited, have just fully established the validity of their patents in an action against Weldite, Limited.

——o——

CORRESPONDENCE.

BRITISH FOUNDRYMEN'S ASSOCIATION.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I am surprised that before now no one has suggested the formation of a branch of the Foundrymen's Association in the West of Scotland, to meet monthly in Glasgow, where there could be a paper read every month, to be followed by discussion. After a reasonable time had been allowed to discuss the paper, there could be an opportunity given to any member who wanted the opinion of his fellow members on any knotty point, of which there are many. It is not necessary to tell the readers of your journal how many different opinions there are usually when there is a defective casting turned out. Now, I could cite many examples by way of showing the sort of criticism and diversity of opinion that exists. At such a time you will sometimes find that the

most keen critics are the most empty-headed. The meal hour arrives, with your casting lying in the middle of the yard, with the defective part fully exposed. You would think the foreman dresser had taken special care to leave it so. Along comes the man who is held responsible for the job, eager to see how his work looks; but when he notes the unsightly appearance of the casting to which he has for the last fortnight, or perhaps more, given his constant attention, he feels disheartened. It is quite true to say that there is no tradesman who looks with more admiration on his work than the moulder, when it comes out all right. While our friend is casting about for the cause of the defect, along comes critic No. 1, who has a walk round the casting our friend is meditating over, and, without hesitation, gives the cause at once, and then departs. How simple! No sooner has No. 1 moved off, than up comes No. 2, who, in a like manner, gives his verdict—not his opinion—then likewise passes along, and so on till all the moulders have filed past, or there may be no causes left that have not already been voiced. By this time our friend has had about as much information as he could very well digest in such a short space of time. He also passes on to his work, not doubting that he has heard the reason of the defect, but which of them it really is he cannot quite decide. Now, some may say that this case is slightly overdrawn, but I don't think it is; and until moulders are expected to give an intelligent reason along with their opinion, so long will we have with us slipshod critics. In conclusion, I would suggest that if this suggestion comes to anything, as I hope it will, that it will be open to moulders of all ranks, and have no sign of caste about it. It is no unknown thing in this district to find an intelligent moulder who knows a little of the technicalities of his trade, but who is neither foreman nor manager. Hoping to see an expression of opinion on this very important matter,

Yours, etc.,

A. L.

Paisley, N.B.

FIG. 3.—THE "U" SECTION AFTER REPAIR.

——o——

MESSRS. A. COX and F. BROWN, engineers, Rushden, trading under the style of Cox & Brown, have dissolved partnership.

THE MERTON METALLURGICAL COMPANY, LIMITED, of 4, Sun Court, Cornhill, London, E.C., has been registered with a capital of £1,000,000, with the object of carrying on metallurgical, mining, and industrial business.

THE AMERICAN ENGINEERING SOCIETIES' BUILDING.

We have before referred in these columns to the new building which has been erected in New York as a home for several of the American technical societies. This building is now completed, and has just been dedicated. The building was made possible by the gift, in 1903, by Mr. Andrew Carnegie of one million dollars, to which he subsequently added $500,000, for the purpose of erecting a building which should be a home for the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the Engineers' Club.

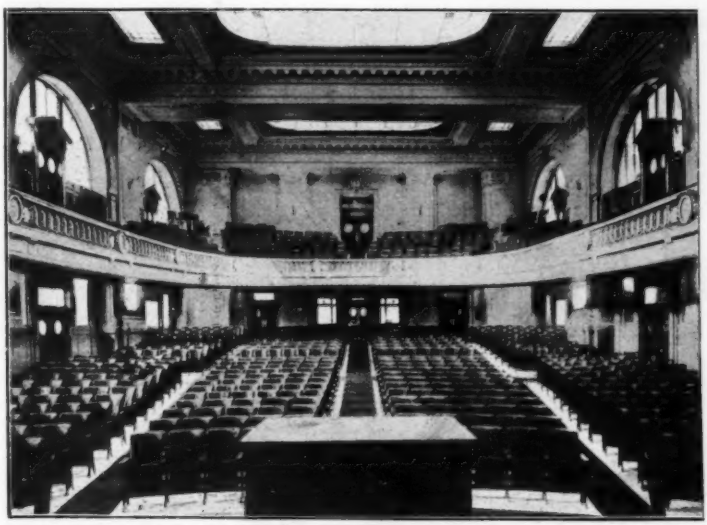


Fig. 1.—Auditorium.

American Engineering Societies' Building at New York.

One of the many complete and commendable features of the building is the main auditorium, extending up through two floors, and, with its gallery, comfortably seating about one thousand persons. On both the parterre and the gallery floor, at the sides the auditorium is sursounded by corridors, rendering access to every point very easy, and permitting ready withdrawal for conversation, committees, etc. The corridors assist also in maintaining quiet within the hall. The seats are fixed opera chairs, in red leather, with revolvable tops.

Seven lecture rooms of various sizes occupy the two floors immediately above the auditorium. These are so arranged that the building can accommodate audiences of from 1,000 to 100.

The seventh and eighth floors of the building have been reserved for the associate societies that have engineering or some department of science as their principal object. For these organisations the building affords office areas of varying size, from one room up, with the common facilities of the lecture rooms, library, and other accessories. Among these societies may be enumerated the Society of Naval Architects and Marine Engineers, the Society of Heating and Ventilating Engineers, the National Electric Light Association, the Society of Chemical Engineers, the New York Electrical Society, the Association of Edison Illuminating Companies, and the American Street and Inter-Urban Railway Association.

Each of the three founder societies occupies a floor laid out in accordance with its own plans. The American Institute of Mining Engineers has the ninth

floor, the American Institute of Electrical Engineers has the tenth floor, and the American Society of Mechanical Engineers has the eleventh floor.

A crowning detail in the plan of the building has been the reservation of the twelfth and thirteenth floors for the libraries of the three founder societies, and of such other collections of engineering literature as may be added.

A hope was expressed in some quarters that Mr. Andrew Carnegie might see his way clear to do for English Engineering Societies the same service as he had done for those of America. So far, however, this has not come to pass.

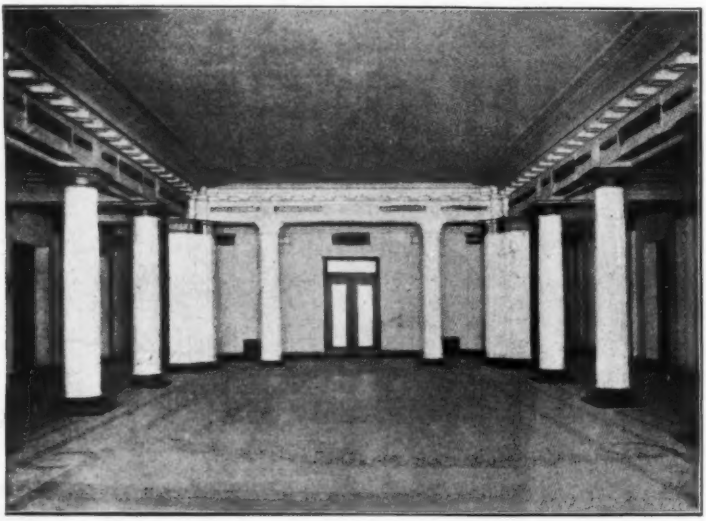


FIG. 2.—ENTRANCE HALL.

AMERICAN ENGINEERING SOCIETIES' BUILDING AT NEW YORK.

—o—

T. L. SCOTT & COMPANY, LIMITED, engineers, have moved their offices to Martin's Chambers, 28, Martin's Lane, Cannon Street, E.C.

THE GRANGEMOUTH AND GREENOCK DOCKYARD COMPANY are supplying a floating crane pontoon for the yard of Messrs. Harland & Wolff, Belfast. The dimensions are 150 ft. by 85 ft. by 13 ft. On this pontoon a large electric crane, capable of lifting 150 tons to a height of 150 ft., will be erected.

A LOAM MOULD.

By R. D. W.

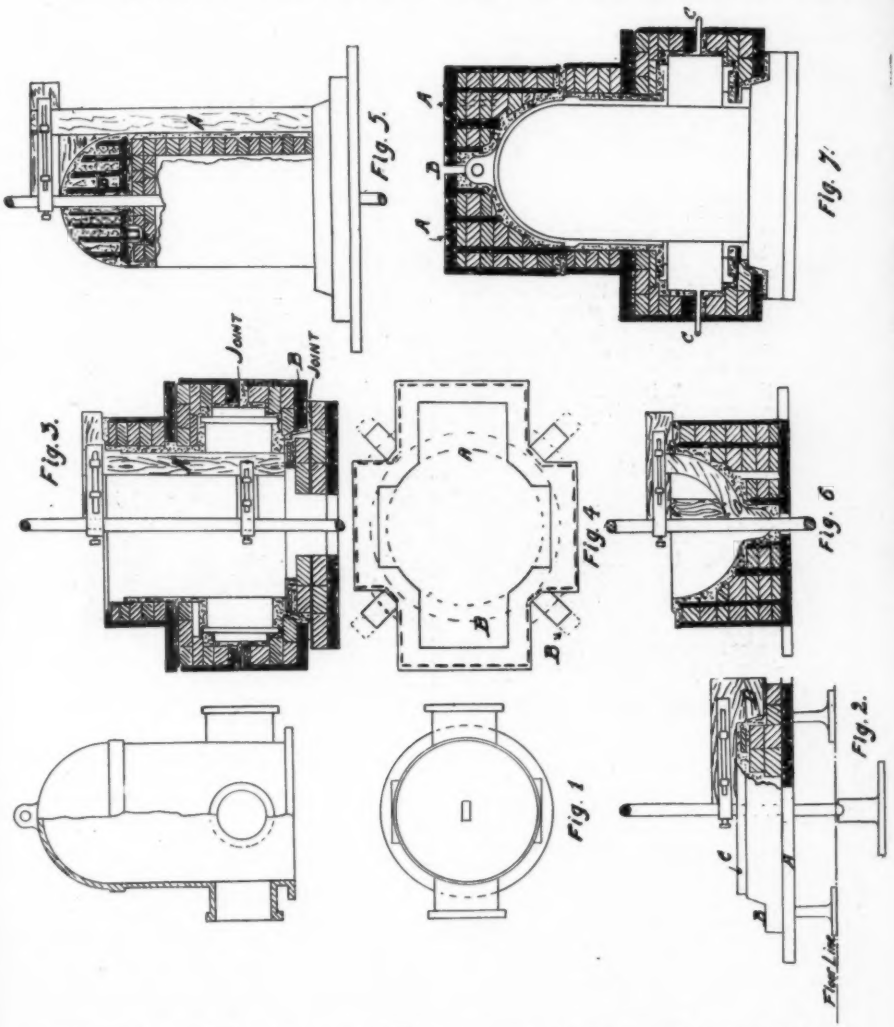
THE air vessel shown in plan and part sectional elevation in Fig. 1 is the article to be moulded. The method adopted is by means of sweeping boards; the mould being built up on cast-iron plates, with dabbers cast on, to form a rigid casing, and thus to save the time and expense of ramming the mould up before casting and digging it out afterwards.

The construction of this mould and general loam work is best done by means of a spindle, with a seating bedded permanently in the floor, an overhead arm held in position by means of a stretcher being fixed to hold it steady at the top. Two arms to fit the spindle and provided with set screws, as shown in the various figures, will also be required.

Patterns to form the branches and the lifting eye on the top of the casting will be necessary, also various boards, which will be described later on.

To commence the mould, three cast-iron stands are bedded firmly on the floor, around the spindle seating, and such a distance from it as will suit the plate to be placed on them, and levelled by means

of a straight-edge and spirit-level, pieces of iron packing being placed on the tops of the stands where necessary. A round bottom plate about 5 ft. 6 in. in diameter, 2½ in. thick, with an 18-in. hole in the centre, and four lifting lugs on, is either found or made and placed on the stands. The spindle is placed in position with an arm attached, and the plate set exactly central. The seat-board D, Fig. 2, is fastened to the arm, and the seat and dummy flange bricked up and swept, as shown in Fig. 2, A being the plate, B the tapered joint, and C the dummy flange. Two stands are shown in position, also the spindle and seating. The board and spindle can now be removed, the seat covered over by means of bars and sheet-iron plates, and a coke fire made under the plate, keeping clear of the stands. Similar plates are placed round the job, and the fire allowed to burn out during the night. The seat will be dry next morning, when the next part of the



mould, which is the cope, can be commenced.

The spindle with two arms attached is lifted into its seat and secured at the top by means of the arm and stretcher. The cope-board, shown at A in Fig. 3, is fastened to the arms, being kept a little clear of the flange. Two centre lines, to set the branches by, are struck across, and the board and spindle lifted away. Parting sand is sprinkled on the joint, about $\frac{3}{4}$ in. of stiff loam spread over, and a plate, as shown at B in Fig. 3, bedded on. The spindle and board are replaced and the mould bricked up, irons or light grates being placed under the branches, which are set in position by means of the centre lines and a mark on the board for the height. The bricking is continued to the centre of the branches and a joint made, and either allowed to stand overnight or stiffened by means of fine, hot ashes. When sufficiently stiff, a plate similar to the last on the outside, but made to clear the branches and the body of the mould, is bedded on in the same manner as the last. The bricking is continued, irons being laid over the branches to carry the loam and bricks, hay or straw ropes being used to bring away the vent. When the top of the prods is reached, another plate, similar in outline to the others, but made to clear the body inside, is bedded on. The prods in this plate are brought in so that there is just room for a single brick wall inside the prods. The bricking is continued to the top, the two top plates cramped together, and the inside faced up with loam and swept the correct size. The spindle and board are now lifted out, guide marks made on the two joints, and the mould parted, the branch patterns withdrawn, the mould dressed up, and the cope lifted on to the stove carriage ready for drying. Fig. 3 shows the mould in section previous to lifting and will be self-explanatory. The plates are shown in Fig. 4, which shows the plates made to clear the branches, the dotted lines at A showing the inside of the top cope-plate, the bottom one being the same except that the inside is made to clear the tapered joint, as shown by dotted lines at B, B.

The core claims our attention next. The spindle with one arm attached is placed in position; the dummy flange cut away, care being taken to leave some of the edge at the top of the tapered part intact, for a guide to set the board to. The board is shown at A in Fig. 5, and is fastened to the arm, being kept just clear of the edge which was left for a guide. The core is now bricked up. A single brick wall with a loam brick in each course, is all that is required up to the dome, when a plate, made as shown at B, Fig. 5—which depicts the core partly in section—is bedded on. The space between the prods is filled up with pieces of brick, bedded in loam and a few ashes, holes being provided in the plate for the air to get away into the inside of the core. The building being finished, the bricks are faced with loam and the core swept to size. The crown plate can be fastened down to the bottom plate by means of bolts or cramps inserted into the staples, shown at C, Fig. 5. The board is removed, the spindle lifted away, and the core lifted on to the carriage ready for the stove.

A top plate is made, as shown in Fig. 6, and placed on the stands, the spindle again fixed and the board shown attached. The plate is then bricked up, runners being inserted in holes provided for them while doing so. The board sweeps a small dome, into which after the top is swept and the spindle lifted out, the pattern for the lifting eye is placed, and the surplus space filled in with loam. The hole provided for the spindle is used for the riser. All parts are now dried, dressed up, and blackened, the branch cores made, and all is ready to close the mould for casting.

A level bed is made in a pit or hole dug in the floor for convenience of casting and the bottom plate and centre core combined lifted on to it. A trench is made under the plate to allow the vent to come away from the core. The bottom half of the cope is lowered over the core, the branch cores set, and vent pipes inserted to bring the vent away from them; studs are placed under the long branch cores to keep them up. The top half of the cope is now lowered on, care being exercised to see that the studs for holding down the branch cores touch the mould, also that the core prints touch but do not crush the cores. The joints are stopped in with loam, and the plates cramped together. The top of the mould is now placed in position, being set by means of the dowel, and pieces of clay used, to see that the thickness of metal on the top of the core is correct. This joint is also stopped in, and the whole mould cramped securely together. The runners and riser is made up with sand and the job is ready for the metal.

Fig. 7 shows the mould put together for casting with the cope and top in section, A being the runners, B the riser, and C the vent pipes for the branch cores. The plates being prodded, it is not necessary to ram the mould up, thus saving much time and labour.

PIPE-FOUNDING IN CANADA.*

INASMUCH as Canada is one of the most progressive countries in the world to-day, a brief survey of her resources for supplying pipes for water and gas should be of unusual interest. At the present time five pipe foundries supply the wants of the country, located respectively at Hamilton and Toronto, in Ontario; Londonderry in Nova Scotia; and Three Rivers, in the Province of Quebec. The total output of pipes in 1905 was estimated at about 21,500 tons. This figure, however, did not represent the pipes used in Canada; for although the high tariff of $8 practically shuts out the American manufacturers, the preference tariff of $5.33 a ton against Great Britain lets in the Scotch and English makers, who have succeeded in filling orders for seaport municipalities in Canada at prices which it is claimed would be ruinous to Canadian manufacturers.

The Montreal Pipe Foundry Company's plant is situated on the western bank, and near the mouth of the St. Maurice River, where it delivers into the St. Lawrence.

The works proper have a daily capacity of 35 tons, or 10,000 tons annually. The number of men employed is less than in most pipe foundries, due to the unique labour-saving appliances which confront one at every turn as we pass through the various departments. The general plan is almost in the form of a Latin cross: the top consisting of offices, stores, forge, machine shop, and power house; the arms of jobbing foundry, cupola house, and general repair shop; while the trunk forms main foundry, core ovens, pipe cleaning, testing and dipping shops; all planned so that raw materials go in at one end and finished pipes come out at the other.

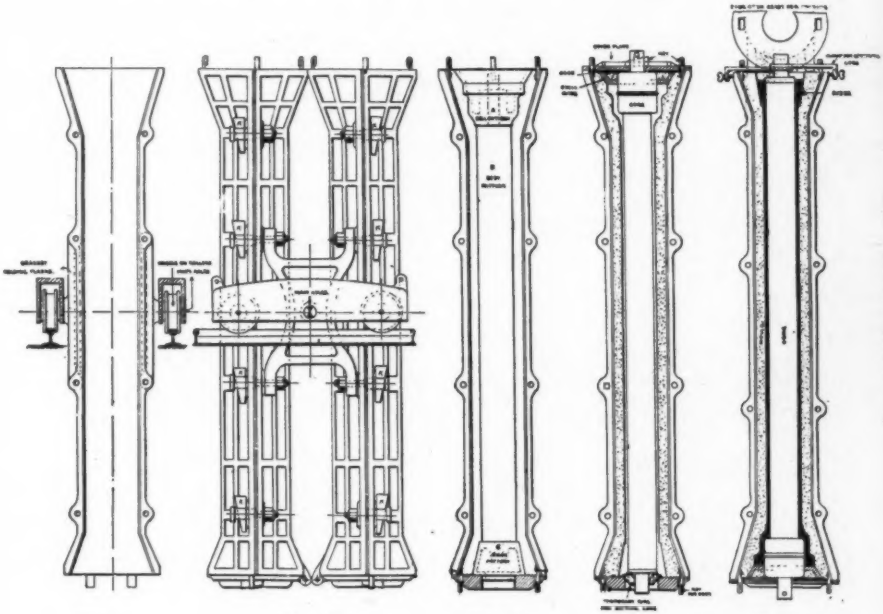


FIG. 1. FIG. 2. FIG. 3 FIG. 4. FIG. 5.

Machine Shop.

On the way to the pipe foundry, we first pass through the machine shop, 200 by 70 ft. Two side galleries run the whole length of the building, on which the pattern-making is done. The core-making department adjoins the machine shop.

* From "The Canadian Engineer."

Pipe Foundry Iron Supplies.

Three brands of pig-iron are used in this foundry, viz., "Londonderry," Nos. 1 and 4; "Port Clarence," No. 1; and "Summerlee." The first named are made at the Drummond furnaces in Nova Scotia, and have the following analyses :—

No. 1—Si. 3.76; S. .017; P. .907; Mn. 1.1.
No. 4—Si. 2.75; S. .075; P. 1.08; Mn. 1.1.

The Port Clarence iron is made in Middlesbrough; while Summerlee is made in Scotland, and is high in silicon; hence, used as a softener. Since phosphorus is a preventive of oxidation, high phosphorus iron is peculiarly suitable in the manufacture of cast-iron water pipes; and the owners of the Three Rivers pipe foundry are fortunate in being also the proprietors of both mines and blast furnaces from whence they get most of their pig-iron. Keep's well-known system of mechanical tests is used.

(1) *Shrinkage and Chill.*—Two bars cast daily, ½ in. square by 10 in. long.

(2) *Transverse Fracture Test.*—Three bars cast daily, 1 in. square by 12 in. long.

The flux for the cupola consists of local limestone, and the fuel, Connellsville coke, imported from Pennsylvania. These supplies, together with the pig-iron, are elevated to the charging platform in steel skips, by means of an incline and wire rope drive. A series of five turn-tables at the entrance end of the 30 by 50 ft. charging house, transfer the respective materials (which are carefully weighed) on 30-in. tracks to the cupola mouth. Two cupolas, 80 in. and 56 in. diameter respectively, furnish metal to the foundries. The blast is delivered through 2 by 12 in. vertical tuyeres by means of a Sturtevant fan blower, electrically driven. By way of a narrow doorway in the cupola house we enter the main pipe foundry, which is 170 ft. long by 40 ft. span.

On the left of the cupolas are a series of core ovens projecting outside the wall of the main building and heated by means of coke-fired grates of approved construction, located below ground at the rear.

Hay rope binding for solid shell core barrels is an old and effective device; but a mixture of loam, sawdust, and hydrated starch—as used at the "Addyston" foundries in the U.S.A., and at Cochrane's foundries, Middlesbrough—is an equally effective, cleaner, and much more economical core material for the making of pipes in vertical moulds. Important improvements are contemplated in this section, so that in a little while the core-making department will be as "up-to-date" as any part of the plant. From near the 5-ton mixing ladle in front of the cupolas, we turn our attention to the work going on down the middle bay, where two electric cranes, 10 tons and 5 tons capacity respectively, were hoisting cores, swinging flasks, etc., over the 100-ft. longitudinal pits, in which pipes can be moulded and cast with remarkable rapidity.

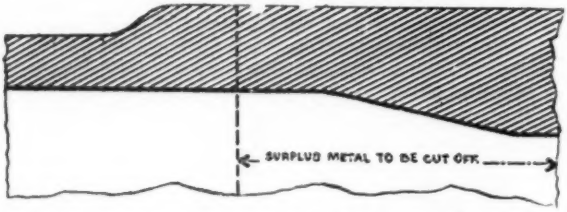


FIG. 6.—FULL-SIZE SECTION OF BEAD FROM 6-IN. PIPE, SHOWING SURPLUS METAL CAST ON, TO BE SUBSEQUENTLY CUT OFF IN THE LATHE, IN ORDER TO ENSURE A SOLID, CLEAN END OF PIPE.

Mode of Manufacture.

The pipe-moulding area consists of two 50-ft. narrow pits, provided with rail tracks upon which the pipe flasks—connected in pairs in one, and in fours on the other—are moved along on four-wheeled carriages, having swinging axles as per Figs. 1 and 2.

The cast iron flasks are made in hinged halves, bolted together, and secured by means of the keys "K" (Fig. 2). The cone or riser pattern "C" (Fig. 3) is then set in the door at bottom, closed, and also fastened by tightly driven taper cotters. The body pattern "B" is lowered by crane into position, and the

mould rammed up as far as the bell pattern.

The bell pattern "A" is slipped over, and the ramming of mould completed. The body pattern "B" is lifted by the crane, bell and riser mould slicked, and a pail of special facing mixture—imported from Scotland—swirled down the mould, the surplus wash dropping into a tank. The pitman then adjusts the temporary setting ring (Fig. 4), and the moulds are pushed into the oven at the lower end of pits to be dried overnight. In the morning the entire series of moulds are drawn out of the ovens and the core is lowered in, and set as shown in Fig. 4. The top chill ring is then put on, a covering of moulding sand is carefully packed, and cover plate set in place and tightly keyed on. When all the cores are thus in place, the mould carriages are all spaced, and the flasks, by means of the crane, are turned over: the spigot end being now at the top and the bell at the bottom. The temporary setting rings are now removed, the spigot or "bead" end of the core being carefully centred by clamps as per Fig. 5; gauges being used to ensure the core being concentric with the mould. The hinged door on top is now tilted and the moulds are poured full, the riser being 5 or 6 in. high, after which the runner gate, together with a portion of the riser, is broken off while in a semi-molten condition.

Soon after the metal in the moulds is set the flasks are turned upside down again, so that the bell is upwards, and the cover plates and chill rings removed, and the core barrel hoisted out by the crane. Then the flask keys "K" are slackened, a drawbar lowered by crane through the pipe, and a triangular "hook" attached to same by the pitman. Straightway the pipe is pulled up out of the flask, and the mould sand falls down into the pit conveyor underneath. The bottom end of the uplifted hot pipe is lowered on to a skid, which enables it by gravity to drop gradually down on to the rail gantry, along which it rolls on to the cleaning department. The burnt sand deposited at bottom of pits is carried through a central culvert in side wall, and elevated at night in buckets on endless chain to mixing department, where the requisite new sand, coal-dust, etc., is added; then the renewed sand is delivered next morning to steel trucks, 6 ft. by 24 in., and used in the ramming of new moulds..

The method adopted in this foundry for the cleaning of pipes is certainly novel. The lower half of an endless chain running at high speed on sprockets located at each end of the pipe is passed through the interior, and by its erosive action removes the adhering mould sand therefrom, and very effectively it does the work. The sand having been removed the pipe is rolled on to a small four-wheel truck, having a central vertical screw, capped with an adjustable saddle, by means of which the pipe can be lifted and connected to lathe headstocks in quick time. In half a minute the surplus metal on bead is cut off, and the spigot end presents a clean, sound and finished appearance. Pneumatic chippers are employed to remove all lumps and rough places on the outside. Following this operation a blast of air from the compressed air line is sent through and over the whole pipe, thoroughly removing all sand and metal dust from the skin. The pipes are now rolled into an oven and evenly heated to a temperature of about 450 degrees F., then picked up by a 5-ton air hoist and dipped into a tank containing an antiseptic tar solution and well coated. From thence, rolled on the continuous rail gantry to the hydrostatic testing press, the movable headstock on which is shifted by means of a powerful set of compound gears, having high mechanical advantage; and each pipe when adjusted is subjected to a hydrostatic pressure of 300 lbs. per square inch. They are then rolled out of the testing press on to the scales, and there carefully weighed and recorded.

From the secondary operation of hoisting the newly cast pipes out of the flasks and depositing them on the cleaning gantry to the final operation of weighing, the process is entirely continuous; and in this respect the Three Rivers plant is one of the best examples to be seen of a foundry laid out systematically and logically with a view to economy in production.

After weighing, the pipes are carried to their respective piles in the stockyard, ready for shipment in accordance with contract.

Allied with every straight pipe foundry is a department for the manufacture of irregular pipes, such as tees, crosses, elbows, bends, collars, etc.

The jobbing foundry in these works is an ell-shaped building, 70 by 50 ft., extending from the right of the cupola house, and forming one arm of the cross. This department is the least modern of the whole plant as regards equipment. In the making of elbows, for instance, the drag half of cores consists of dry sand, while the cope half is made of green sand,

with the exception of the curved part forming junction of angle, which is made of dry sand. All the irregular pipes after cleaning are heated and painted with a tar mixture of similar composition to that of the famous antiseptic solution of Dr. Angus Smith.

Looking back in perspective, the following features, having unusual merit, stand out prominently:—(1) The care with which the materials used in the manufacture of the pipes are selected and handled; (2) the altogether admirable method of making moulds with bell at top and bead at bottom; but by reversal, pouring the moulds with bell downwards and bead upwards, for the casting of bell downwards ensures—due to head pressure of metal—close-grained iron at the shoulder of socket, where there is danger of porosity due to irregular sectioning and, hence, unequal shrinkage; while the casting of an elongated bead—say 6 in. long—which is subsequently cut off in the lathe, guarantees a sound, solid, spigot end; and (3) the evident marks of system and scientific method which pervades the operations on the plant generally.

——o——

A DISSOLUTION of partnership is notified in connection with Messrs. W. Kay and A. Bowes, engineers, Pendleton, Salford, who traded under the style of the Pendleton Iron Works Company.

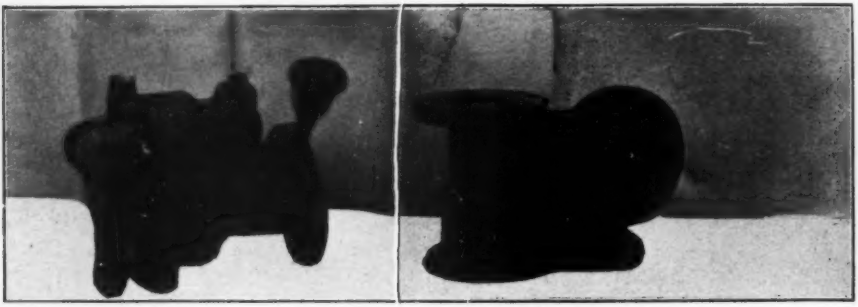
THE STIRLING BOILER COMPANY, LIMITED, of Motherwell, are supplying two boilers, superheaters, and chain-grate stokers for the Urban District Council of Handsworth; two boilers, superheaters, and chain-grate stokers for Sheffield Corporation Tramways; and one boiler, superheater, and chain-grate stoker for the Copenhagen Electric Tramways Company.

ENGINEERING BRASS FOUNDRY.

BY J. CLEMENTS.

THE above heading to this "article" embraces a very large proportion of the brass founding as carried on to-day, but to particularise, I may say at once, that I intend to confine myself this time, with your Editor's permission, to the casting of "check valves."

In the illustration below will be seen two of these castings, one still with runner and risers on. Check valves, I know, are also largely cast in iron, too, but in the present instance there was, no doubt, good reasons that influenced the firm whom I serve for passing by after many years the iron check valves, and substituting in their place gun metal ones.



Expansion and contraction, for instance, would take place more readily in the latter case than the former, owing to the greater malleability and structure; but to proceed in the casting of same, to be successful, good wires will require to be made and an open and loamy sand for cores, etc.

Then our first work after getting the wires made to follow out the core is the core itself. This, in turn, should be made out of sand that is strong enough, and at the same time porous, a good sand rich in loam. This in turn, being made and dried in the usual way, should then be dipped in blacking made of good plumbago and water. Care must be taken in dipping by not allowing the core to be saturated, but quickly immersed, otherwise the core may disappear altogether.

Next comes the mould, which has to be carefully made, and will require a three-parted box, and here, I may say, do not use too good or new sand for this, excepting in parts that are more than usually difficult. Then a little might be

used to bolster up the old, and nails and gaggers, too, for the same purpose or for any deep lifts under flanges, etc.

Deep and ungainly boxes need not be used either, so long as depth of runner head be got by putting a cup on top.

Of course, in making up the mould, if it is intended to dry same in stove previous to casting, any new sand may be used at discretion. The foregoing description only applies when it is intended to make up as dry as possible and obviate drying in the stove preparatory to casting.

We have now presumably got the core and mould made, patterns drawn, with runner and gates where possible to flanges, or to run parallel with core and not drive against them, thus doing away with the possibility of scabs that are so often caused by friction in green sand moulds, and the gating of heavy castings from one place, when two might be quite as convenient, thus saving this friction by a quick distribution of metal over several places, instead of one. To those who doubt this, I say, get a heavy brass or similar casting, and try to run it first from one place and then from two, and see how much cleaner is the one that is filled in quickly.

But in the present case our casting is gated from one place, as will be seen from the illustrations, this being placed to run parallel with the core. Risers will also be seen from the flanges, these affecting the castings in two ways; first, during the casting of same, they relieve the pressure that always takes place, by the accumulation of any gases being forced upward as the metal fills the mould; and, secondly, they bring up the flanges, as the higher portions in a sounder state with gases excluded, and the risers filling in as contraction takes place.

——o——

Sir W. G. Armstrong, Whitworth & Company, Limited, are engaged upon another crane similar to one recently brought into use on the jetty at Elswick, weighing 1,200 tons.

The following companies are in course of being wound up:—Waverley Engineering Syndicate, Limited; Manchester and Milford Engineering Company, Limited; the Glamorgan Spelter Company, Limited; the Anglo-Belgian Construction Syndicate, Limited; the Reform Castings, Limited; and the Escaut Foundries and Extensions, Limited.

STEEL MAKING AT WEST DRAYTON.

The Schwartz Steel Process.

At the works of the Roc Steel Castings Company, at West Drayton, Middlesex, steel is being made by a process evolved by Mr. E. H. Schwartz, inventor of the Schwartz melting and refining furnace. In the refining process a Schwartz furnace is used with oil as the fuel. The process differs slightly at the different works where it is in use, but generally may be described as follows:—For melting a portion of the metal to be refined a

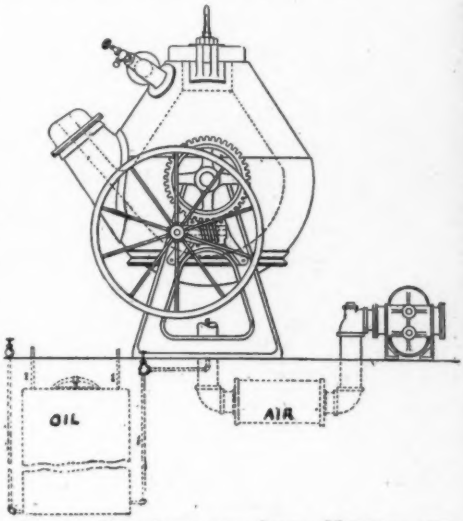


Fig. 1.—The Schwartz Steel Melting and Refining Furnace.

cupola is used, although a part of the heat is raised to the melting point in the furnace. The cupola is charged with one ton of low phosphorus pig-iron containing about 1 per cent. of silicon and 2,300 pounds of return melt steel scrap. While this charge is being raised to the proper temperature, 800 pounds of return melt steel scrap and 2,400 pounds of low phosphorus pig-iron are being heated to about the melting point in the furnace. The cupola charge when melted is poured into the Schwartz furnace, and on account of the large amount of steel scrap, it is claimed that the entire carbon content is below 2 per cent., and is further reduced to 0.25 per cent. in approximately 2½ hours by the oxidising flame in the furnace. The metal is superheated by burning the car-

bonic oxide liberated during the refining process, and the high heat necessary to burn this gas is obtained from two converging blow pipe tuyeres located near the top of the furnace. The flame enters the furnace jets, passes down on the metal bath, makes two revolving turns and then passes out the spout. The inventor states that a temperature of over 4,000 degrees F. is obtained in the furnace, and that a perfect oxidising flame can be controlled by the ¼-in. needle point valve located at the side of the furnace.

After the heat has been applied to the entire furnace charge for 1½ hours tests are made, and 15 minutes before pouring

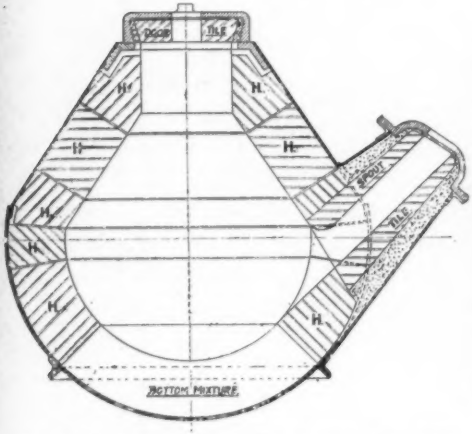


FIG. 2.—ENLARGED SECTIONAL VIEW OF SCHWARTZ FURNACE.

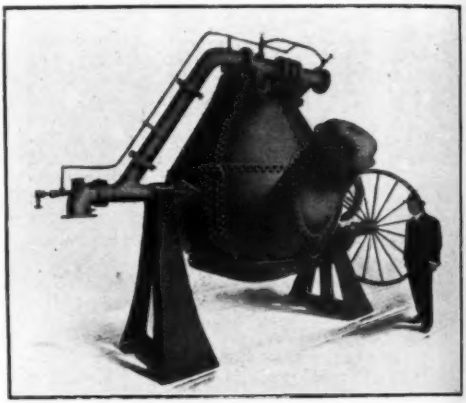


FIG 3.—GENERAL VIEW OF SCHWARTZ STEEL MELTING AND REFINING FURNACE.

ferro-silicon and ferro-manganese are added. Aluminium in quantities of 2½ lbs. per ton of steel is placed in the ladle before the heat is poured. While the pig-iron and steel scrap are being melted in the cupola, sulphur and phosphorus are absorbed from the coke, but the total furnace charge is lowered as the initial charge in this vessel shows no increase of either sulphur or phosphorus owing to the use of oil fuel. Extensive tests have been made that show no increase of either sulphur or phosphorus from the oil. The pig-iron and scrap are gradually charged into the cupola, and as a blast pressure of only 9 ozs. is maintained, oxidation is reduced to a minimum. Approximately four tons of steel can be made by this process in 4 hours, and castings ranging from 2 ozs. to 2,500 lbs. can be poured. Eighty gallons of oil for a ton of steel are consumed and the cupola melt ratio is about 1 to 6. By the use of two Schwartz furnaces a cupola will not be required, and the inventor claims that a high grade of acid steel can be made.

It is further claimed that malleable iron can be made by the use of this furnace and a cupola. In this case 60 per cent. of the charge is to consist of return melt scrap with a mixture of steel scrap, as desired, and this is melted in a cupola with a low blast pressure and sufficient coke. The remaining 40 per cent. of the charge is melted in the furnace and consists of pig-iron, either malleable Bessemer or charcoal. The cupola charge is poured into the furnace when the latter has reached the melting point, and the steel charge is melted for about half an hour. If necessary, ferro-silicon can be added to the metal to secure the proper silicon content. It is claimed for this process that a greater amount of scrap can be used than is used either by air furnaces or in open-hearth practice.

——o——

CAMMELL LAIRD & COMPANY, LIMITED, are searching for a suitable site for their new works in the vicinity of Llanelly and Burry Port.

MESSRS. HUGHES, FAWCETT & COMPANY, engineers, of Hebden Bridge, have purchased the business lately carried on by Messrs. Harrison & Horsley, Pomona Iron Works, Cornbrook Road, Manchester, and are transferring it to their works at Hebden Bridge.

THE THOMAS & CLARE CORE-MAKING MACHINE.

This is an American machine for rapidly turning out a number of small and short cores, and is intended for use in foundries requiring a large quantity of cores all the same shape and size. It would seem that this machine does away with the objection so often spoken of in connection with core-moulding machines, namely, the trouble of making the vents. This objection is a serious one, since the time consumed in boring long vents, especially where they have to be 2 in. in diameter, often entirely obviates the apparent saving resulting from the use of the core machine. The machine is similar

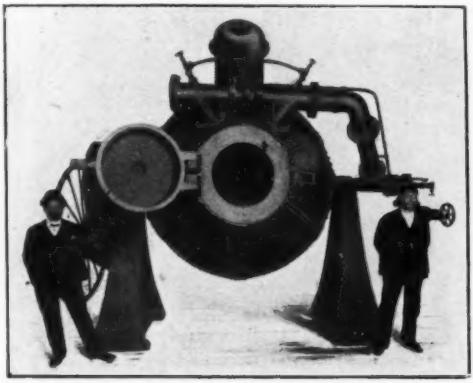


Fig. 4.—Schwartz Furnace Tilted.

to that of Phillips's; it presses the sand sufficiently tight by means of a plunger, and the cover prevents the sand being forced out on to the bench. The machine is made for cores $\frac{5}{8}$-in., $\frac{3}{4}$-in., and $\frac{7}{8}$-in. diameter by 3 in. long, and also for 1-in., $1\frac{1}{4}$-in., and $1\frac{1}{2}$-in. diameter by 4 in. long. The fact that 8 to 10 of the smaller cores can be made at once, gives a good idea of the capacity of the machine. The cross-section, illustrated in Fig. 1, shows how easily the moulds and plungers can be changed, and the strong construction of the machine. A noteworthy feature is the absence of cast iron parts, of which there are usually a number in machines of this kind.

—o—

The Glasgow offices of Messrs. R. & A. Main, Limited, engineers, have been removed to 136, Renfield Street.

SILICON IN THE BRASS FOUNDRY.

Cupro-silicon acts upon copper in almost the same manner as phosphorus. It has proved itself to be a natural alloy and flux or reducing agent to the oxide of copper produced when the latter is in a molten condition. It is, therefore, active in clarifying, refining, hardening, and strengthening copper and its alloys. In this respect it is as vigorous and pronounced as phosphorus. There is no violent ebullition when silicon is added to copper or copper alloys, as in the case

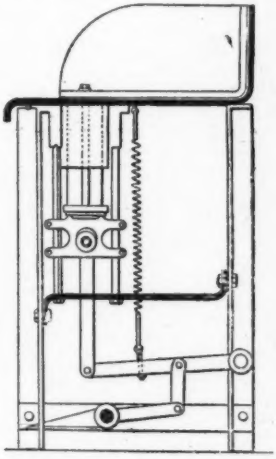


Fig. 1.—Thomas & Clare Core-Making Machine.

of phosphorus. The alloy is exceedingly brittle, and can readily be reduced to small pieces. It is a good agent for the production of sound castings in bronze and brass, and will be found to save in "wasters" its cost many times over. In tin-bronze mixtures, where there is a large percentage of copper, cupro-silicon, to the extent of from 2 to 8 ozs. only is required per 100 lbs. of metal melted. Castings made from metal so treated are close-grained, and possess a strength unattainable by other means. The cupro-silicon should be broken into small pieces, and added to the metal about 10 minutes before pouring, and the contents should be well skimmed and stirred before pouring.

Foundrymen know the difficulties that attend the casting of pure copper successfully.

Cupro-silicon has given good results, requiring from 1-1½ lbs. per 100 lbs. of copper for plain castings, and from 5-7 lbs. in cored castings subject to high internal pressure. The cupro-silicon should be placed in the crucible just before taking from the furnace, and the contents should be well skimmed and stirred before pouring.

Its being placed in the crucible before pouring assures a uniform fluidity and an instant reduction of the oxide of copper. When the right amount of cupro-silicon is used, not a vestige of the silicon remains in the metal. A casting of pure copper is thereby secured. Large electrical conductors, so much in demand at this time, can be cast and marketed at a far lower figure than if worked or forged from rolled copper.

——o——

MESSRS. LENNOX & COMPANY have removed to 27, Essex Place, Turnham Green, W.

A LARGE McCLELLAND'S MOULDING MACHINE.

THIS machine has now been before the public for some years, but the machine shown in the accompanying cut is noteworthy because it is of exceptional size, namely 22 in. by 22 in. The machine is operated by compressed air, which is preferable to steam or hydraulic power, which, however, can both be used. The air pressure is 80 lbs., although considerably less can be used on light work. The machine is really a double one. This is effected by fitting the pattern plates on two carriages, one on either side of the ramming frame, the wheels resting on V-section rails, so that when the moulding box has been put on the pattern plate and filled with sand it is pushed under the ramming frame, the power turned on, the rammer is put into action, and the movement is so rapid that it is almost instantaneous. After ramming, the car-

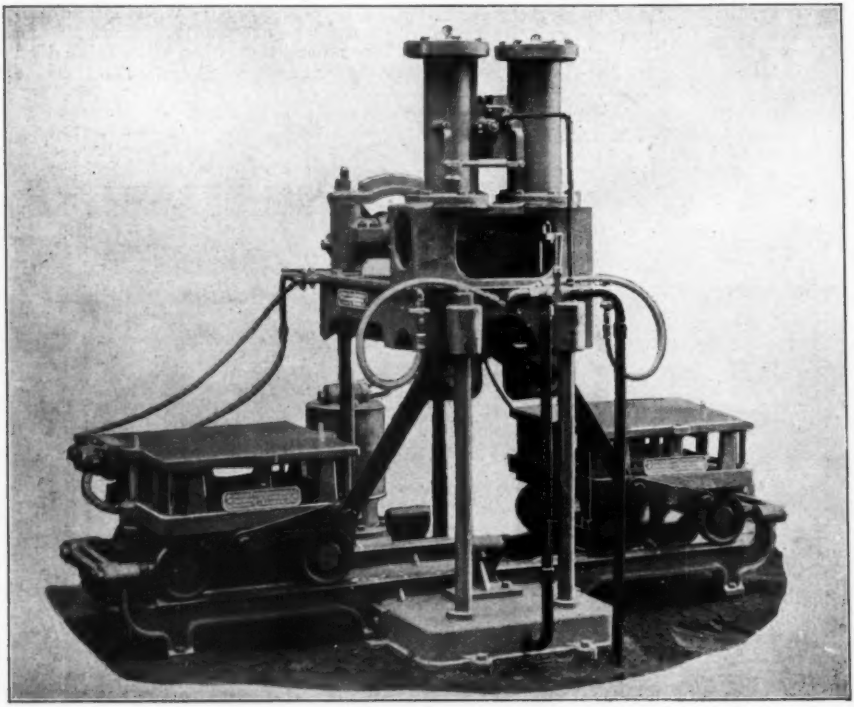


FIG. 1.—LARGE MCCLELLAND MOULDING MACHINE.

1
2
3
4
5
6
7
8
9
10
11
12A
12
13
14
15
16
17
18
19
20
21

riage is withdrawn, and while the mould is being placed on the floor and a fresh box adjusted, the operator working the carriage on the opposite side has a free course to perform the same operation without interfering in any way with the man on the other side of the machine. By this arrangement its capacity is made very large. An ingenious design of sixteen small rammers, fitted to adjustable springs, ensures equal ramming all over the mould, and does away with carved wood blocks. The machine is fitted with a vibrating or rapping attachment, and snap flasks may be used as well as ordinary boxes. The depth of draw of patterns is not limited, although stripping plates are not used. Ordinary plate moulding patterns can be brought into use at a very trifling outlay. The castings shown herewith have been photographed with a view to demonstrating the wide range of work to which the machine adapts itself. The machine used in making the moulds from which these castings were taken is a smaller size, and has two plates, 16 in. by 16 in. The details follow:—

Photo No.	No. of patterns on plate.	Complete moulds per hour.	Complete castings prepared for per hour.
1	2	40	80
2	2	30	60
3	2	30	60
4	4	30	120
5	4	30	120
6	2	30	60
7	2	30	60
8	2	30	60
9	2	40	80
10	2	40	80
11	2	40	80
12	1	30	30
12A	1	20	20
13	1	40	40
14	1	30	30
15	9	30	270
16	9	30	270
17	2	40	80
18	1	40	40
19	30	40	1,200
20	1	40	40
21	2	30	60

We are indebted to the Safety Tread Syndicate, of 15, Barbican, E.C., for the above particulars.

——o——

CONSIDERABLE extensions are about to be carried out at the works of Thomas Firth & Company, Limited, Sheffield. The Siemens' steel and steel foundry departments are to be enlarged, and the crucible steel department is to be transferred from the Norfolk Works to Tinsley.

NEW COMPANIES.

ANGLO-NORWEGIAN ALUMINIUM COMPANY, LIMITED.—Capital £10,000, in £1 shares.

NEVILLE MACHINE AND TOOL COMPANY, LIMITED.—Capital £4,000. Registered office: 7, James Street, Liverpool.

ALUMINIUM CORPORATION LIMITED.—Capital £500,000. Registered office: Basildon House, Moorgate Street, E.C.

GRAMPIAN ENGINEERING AND MOTOR COMPANY, LIMITED.—Capital £5,000. Registered office: Causewayside, Stirling.

LAKE ENGINEERING COMPANY, LIMITED.—Capital £200. Registered office: Room 62, Carlton House, 11D, Regent Street, London.

MILANS, LIMITED.—Capital £1,000, to carry on the business of engineers, etc. Registered office: 175, Lockwood Road, Huddersfield.

HENRY SIMON (AUSTRALIA), LIMITED.—Capital £10,000, to acquire the engineering business of Henry Simon, Limited, Sydney, N.S.W.

T. A. W. CLARKE, LIMITED.—Capital £5,000, to acquire the business carried on at Havelock Iron Works, Clarendon Street, Leicester.

UNITED DELTA ENGINEERS, LIMITED.—Capital £200,000, to carry on in Egypt, the Soudan, and elsewhere, the business of mechanical engineers, etc.

PRETORIA ENGINEERING AND MOTOR WORKS, LIMITED.—Captal £500, to acquire the engineering business carried on by W. C. Davies at Brownhill Road, S.E.

MCALPINE & COMPANY, LIMITED.—Capital £10,000, to carry on the business of hydraulic and general engineers, etc. Registered office: Thistle Works, Campbell Street, Govan, Glasgow.

GRIFFIN ENGINEERING COMPANY, LIMITED.—Capital £100,000, to take over the business carried on at the Kingston Iron Works, Bath. Registered office: Palace Chambers, 9, Bridge Street, Westminster.

GOODACRE, GLOVER & BUTLER, LIMITED.—Capital £2,000, to acquire the engineering business of Goodacre, Glover & Butler, Norfolk Place and Canal Street, Nottingham. Registered office: 7, Canal Street, Nottingham.

ALTENBACH, LIMITED.—Capital £8,500, to take over the business of manufacturers of castings in malleable iron and steel, etc., carried on by P. Altenbach, at Helvetia Steel Works, Brighouse. Registered office: Birds Royd, Brighouse.

LIST OF NEW INVENTIONS.

Specially compiled for THE FOUNDRY TRADE JOURNAL by MR. GEORGE BARKER, Fellow of the Chartered Institute of Patent Agents, Consulting Engineer and Chartered Patent Agent, 77, Colmore Row, BIRMINGHAM.

7,506. C. H. THOMPSON. Improvements relating to gas furnaces.

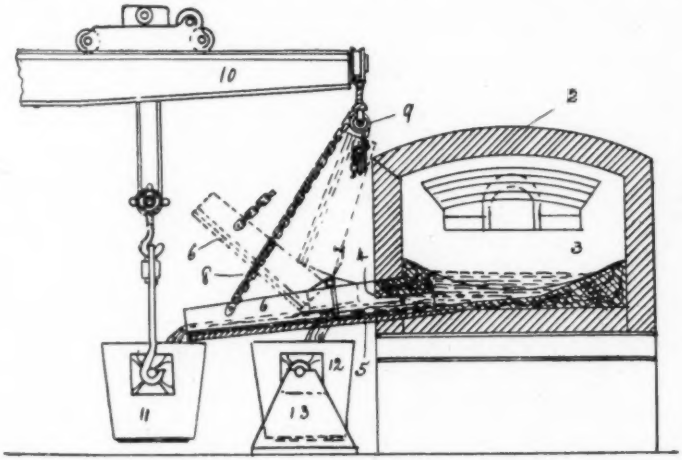
7,580. B. RATHMELL. Improvements in and relating to compressors.

19,633. 1906. J. A. DRAIN, Pittsburg.

The object of this invention is to provide a method by which the metal of a single furnace of large capacity may be drawn off into different ladles as may be desired without the waste of metal and without risk of injury to the workmen.

It has often been found difficult by foundrymen to economically cast steel in small quantities, as, when the furnace is once opened, all the metal must be run off, as a closed blowhole cannot be re-opened. If, on the other hand, all the metal be run into one large ladle of 50 or 60 tons capacity, it becomes dangerous to move such a large ladle about the foundry, and if not actually dangerous, it often spoils the metal by letting it get too cold for good casting. This invention, therefore, aims at drawing off the metal from an ordinary open-hearth furnace into a series of ladles which can be moved about at will.

In the drawing, 2 shows a suitable open-hearth furnace of the ordinary type, provided with the hearth 3, on which the steel is melted. This furnace may be of any capacity. The tap hole 4 is provided for drawing off the metal, and may be plugged with dolomite during the melting. The pouring spout consists of the stationary section 5 and the movable or swinging section 6, which may be suitably hinged to the section 5 as shown at 7. The outer end of the section 5 and the inner end of section 6 of the spout may abut against each other, and the joint fastened in a convenient manner. The section is fastened to a chain 8 which works on the drum 9 on the pouring floor. The ladles 11 and 12 are of ordinary



construction, the ladle 12 being truncated on a suitable pedestal 17.

The mode of operation is as follows :— The molten metal is run into the first ladle till it is full, and then it can be used at once.

Without stopping the flow, the front part 8 is lifted, and the metal runs into the next ladle till it is full and the furnace empty.

There is no limit to the number of ladles which may be used, so long as there is a section for each ladle.

—o—

APPLEBY'S, LIMITED, have secured a contract from H.M. War Office for the supply and erection of a 120-ton electrical overhead travelling crane for gun dipping at the Royal Gun Factory, Woolwich Arsenal.

TRADE TALK.

MESSRS. B. TURNER and J. W. MAUD, engineers, Halifax, have dissolved partnership.

MESSRS. W. D. FLETCHER and F. B. KILPATRICK, engineers, Glasgow, have dissolved partnership.

MR. A. R. WALMSLEY has acquired the engineering business of Messrs. Geo. Hill & Company, Manchester.

THE AIRDRIE IRON COMPANY, of Airdrie, have been appointed agents in Scotland for the sale of the Rateau fan.

THE LINWOOD MACHINE TOOL COMPANY, LIMITED, have removed their offices, etc., to their works, John Street, Govan, Glasgow.

A FIRE broke out at the Blaenavon engineering shops recently in the pattern store room, doing a considerable amount of damage.

MESSRS. W. J. SYMONS and W. H. SMITH, ironfounders, Sylvan Grove, Camberwell, London, S.E., have dissolved partnership.

THOMAS ROBINSON & SON, LIMITED, Railway Works, Rochdale, have removed their London offices to 79, Queen Victoria Street, E.C.

THE SUNDERLAND FORGE AND ENGINEERING COMPANY, LIMITED, have erected a new building at their Pallion Works, adjoining the present shops.

A RECEIVING order has been made in connection with the affairs of Mrs. E. M. Wearing, Wednesbury, who traded as Mary Wearing & Son, ironfounders.

MESSRS. W. J. SYMONS and P. HENDRA, ironfounders, Sylvan Grove, Camberwell, London, S.E., trading under the style of Symons & Company, have dissolved partnership.

THE discharge from bankruptcy of Mr. C. H. Berry, engineer, 41, Corporation Street, and the Premier Works, Lloyd Street, Manchester, has been suspended for two years.

MOUNTAIN & GIBSON, LIMITED, of the Elton Fold Works, Bury, Lancashire, have removed their London offices to Albert Buildings, 49, Queen Victoria Street, London, E.C.

MESSRS. J. BUTLER & COMPANY, Victoria Iron Works, Halifax, have appointed Messrs. J. E. Lawler & Muirhead, 39, Lime Street, E.C., as their sole London representatives.

MESSRS. R. A. FULLERTON & COMPANY, 116, Hope Street, Glasgow, have been appointed sole Scottish agents for De Bergue & Company, Limited, Strangeways Iron Works, Manchester.

MESSRS. J. CONWAY & COMPANY, Union Boiler Works, Hunslet, Leeds, have amalgamated their business with that of Messrs, Beanland, Perkin & Company, engineers, Neville Street, Leeds.

ALFRED HERBERT, LIMITED, whose Japanese offices are at 224, Yamashita-cho, Yokohama, have been appointed sole agents in Japan by the Bateman Machine-Tool Company, Limited, Leeds.

R. LAIDLAW & SON, of the Alliance Foundry, Glasgow, have obtained an order from the Cowes Urban District Council, for 80 tons of 4-in., 6-in., and 8-in. cast-iron pipes, together with special castings, etc.

THE CHESTERFIELD TUBE COMPANY, LIMITED, who have lately issued £40,000 5 per cent. debentures and £75,000 cumulative and participating 6 per cent. preference shares, have acquired the business and works of the Universal Tube Company, Limited, of Chesterfield.

A WINDING-UP order has been made against the M'Phail & Simpson's Dry Steam Patents Company, Limited, Calder Works, Wakefield. The statement of affairs shows ranking liabilities £28,460, and estimated net assets £8,937, with a total deficiency as regards contributories amounting to £435,532.

W. ATKINS & COMPANY, LIMITED, Reliance Steel Works, Sheffield, have appointed Messrs. Richardson & Company, 106, Adelaide Street West, Toronto, as their Canadian agents. The Company have also appointed Mr. R. C. Powser, 15, Bethlehem Buildings, Johannesburg, as their South African agent.

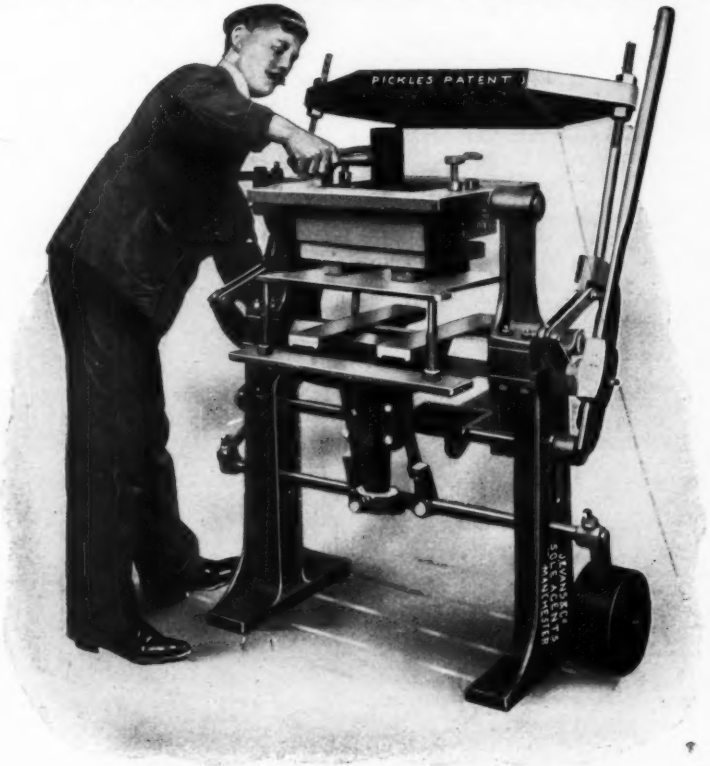
IN connection with the proposed new engineering laboratories at the Heriot-Watt College, Edinburgh, plans have been prepared which will give considerably better accommodation to this department of the College than it at present possesses. The new scheme includes a wood workshop, with floor space of 1,450 square ft.; an iron workshop, with 1,700 square ft.; a motor pit, with 375 square ft.; an engineering laboratory, with 1,480 square ft., with pit for boilers, tanks, etc., of 1,060 square ft.; a laboratory for prime movers, with 1,840 square ft.; an applied mechanics laboratory, with 1,990 square ft.; a strength of materials laboratory, with 1,360 square ft.; and a smithy, with 740 square ft.

NEW MOULDING MACHINE.

PICKLES' PATENT.

ASK FOR LIST AND FULL PARTICULARS.

COMPLETE FOUNDRY EQUIPMENT.



JAMES EVANS & CO.,

Britannia Works, MANCHESTER.

TELEGRAMS: "LADLES, MANCHESTER." "BLACKINGS, GLASGOW." TELEPHONE: 2207, MANCHESTER. 3185, BRIDGETON, GLASGOW.

DEATHS.

MR. P. H. LAING, eldest son of the late Sir James Laing, at the age of 53.

MR. S. GITTUS, manager of Mr. S. E. Stevens' Wagon Works, Hexthorpe, aged 60.

MR. J. DENT, a director of the Blyth Shipbuilding Company, Limited, at the age of 62 years.

MR. E. SUGDEN, chief engineer and works manager of the Yorkshire Engine Company's Works, Wincobank, aged 62 years.

MR. P. GREENHALGH, of Messrs. Greenhalgh & Company, engineers and ironfounders, Atherton, near Bolton, aged 76 years.

MR. R. W. B. CREEKE, managing director of Henry Balfour & Company, Limited, Durie Foundry, Leven, at the age of 53.

MR. E. D. COLQUHOUN, one of the founders of Messrs. Colquhoun & Cadman, merchants and manufacturers of edge-tools, etc., Douglas Works, Sheffield.

MR. J. WHITEHEAD, of the Whitehead Torpedo Company. He was the brother of the late Mr. Robert Whitehead, the inventor of the torpedo, and was associated with various companies.

MR. J. S. KEEP, who was well known in commercial circles in Birmingham and district, in his 87th year. In the course of his business career Mr. Keep became connected with and largely interested in many important companies, amongst which were Elliott's Metal Company, the Midland Wagon Company, the Horseley Company, etc.

SIR DAVID RADCLIFFE, one of the leading public men in Liverpool, at the age of 73 years. Early in life the deceased gentleman entered the engineering establishment in Liverpool of Mr. James Crellin, to whose business he subsequently succeeded. At the time of his death Sir David was a director of Andrew Handyside & Company, Limited.

——o——

PERSONAL.

SIR SAMUEL SADLER has decided to retire from active political work.

THE late Mr. C. H. Bailey, engineer, of Newport, Mon., left estate valued at £158,964 gross.

MAJOR W. A. J. O'MEARA has been appointed to succeed Mr. J. Gavey, C.B., as engineer-in-chief of the General Post Office.

MR. J. WALSH, vice-chairman of Henry Pooley & Son, Limited, has been elected a director of the New Conveyor Company, Limited.

THE late Mr. L. Dougal, managing partner of the Bathgate Foundry Company, left personal estate of the value of £6,613.

MR. A. F. HILLS, chairman of the Thames Iron Works, Shipbuilding and Engineering Company, Limited, has been seriously indisposed.

THE late Mr. W. Cook, of William Cook & Sons, Limited, Sheffield, makers of steel castings, left personal estate of the value of £15,684.

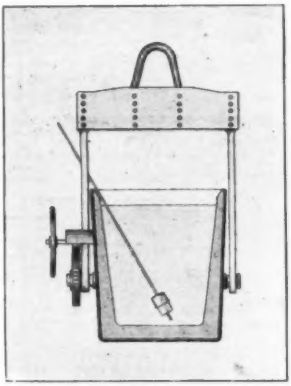
LORD PIRRIE and MR. A. DENNY have lately received the golden emblem of the New Zealand Institute of Marine Engineers as a token of esteem.

THE late Mr. J. D. Ellis, for many years chairman and managing director of John Brown & Company, Limited, left estate of the gross value of £60,752.

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

PREVENTION OF BLOWHOLES IN CAST IRON.



A tin of our special compound fixed on a rod is held at bottom of ladle as shown; a strong re-action being thereby set up frees the iron from gases and impurities, which rise to the top.

RESULT: A denser casting of finer grain with increased strength.

For Particulars apply to—

THERMIT LIMITED,

27, MARTIN'S LANE, CANNON STREET,

Telephone—3749 Central.
Telegrams—"Fulmen," London.

LONDON, E.C.

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1906-7.	1905 6.
Iron—Scotch pig warrants ... ton	*£5 9	—
—Middlesbro' warrants ... ... ton	59 7	48/11
—W.C. M/nos Bessemer ... ... ton	79 6	67/0
—Stock, Scotch, Apl. 30 ...tons	3,912	12,630
Copper—Chill bars, GMB ... ... ton	£107 5 0	£83 17/6
—Stock, Europe & afloat... ... tons	12,958	9,138
Tin—English ingots ton	£193 0 0	£183 0 0
—Straits ... ton	£196 0 0	£181 10 0
—Stock, Ldn. Hlnd and aflt ... tons	10,111	11,209
Lead—English pig ton	£20 13/9	—
Spelter—Ord. Silesian ... ... ton	£25 0 0	—
Quicksilver-(75lb.) bottle	£6 16/0-£7	—
Antimony—Regulus ... ... ton	£88-£92	£80

*Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	7 0 0	to	7 5 0
Pipes, 1½ to 2½ in.	5 10 0	to	5 15 0
,, 3 to 4 in....	5 2 6	to	5 10 0
,, 5 to 8 in.	5 0 0	to	5 2 6
,, 10 to 16 in....	5 0 0	to	5 2 6
,, 18 to 24 in....	5 0 0	to	5 2 6
Chairs	4 2 6	to	4 5 0
Floor plates (open sand)	3 5 0	to	3 7 6

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 17s. 6d.; light wrought, £1 12s. 6d.; heavy cast, £2 10s.; all per ton f.o.b., London. Copper (clean), £91; brass (clean), £66 10s.; lead (usual draft), £19; tea lead, £17 5s.; zinc, £21; all per ton delivered merchant's yard.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

GROUND GANISTER,

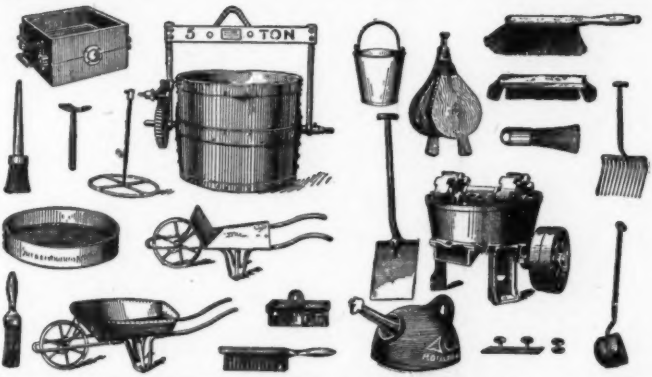
Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Better than Fire-clay Bricks for Cupolas.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE, Near Sheffield.

Manufacturers of all

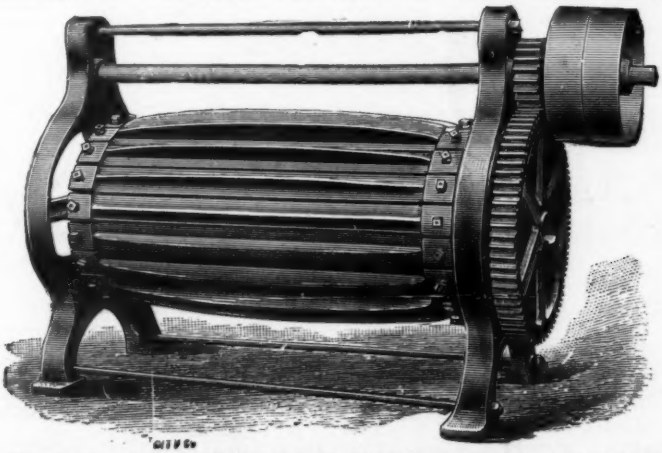
FOUNDRY EQUIPMENTS,

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

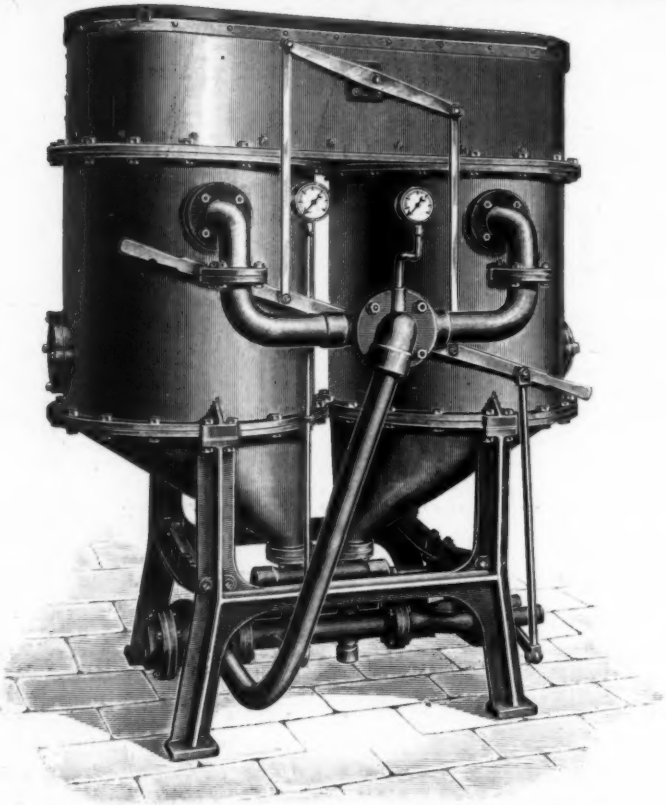
IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

"Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."



Sand Chambers and Pressure Apparatus for our

SAND BLAST APPLIANCES

The first continuous Working Sand Blast on the Market.

NEW CONTINUOUS WORKING TUMBLING BARREL.

Rotary Tables, Turn Tables, Cleaning Rooms, etc., etc.

THE LONDON EMERY WORKS CO.,

PARK, TOTTENHAM, LONDON, N.

SITUATIONS VACANT.

FOUNDRY FOREMAN for Small New Foundry of old-established firm ; thorough practical experience of Bessemer converter, open-hearth furnace, and moulding indispensable. State age, salary, and full details of experience.—Apply Box 435, Offices of the FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

FOR SALE AND WANTED.

FOR SALE, "ROOT'S" PATENT BLOWERS.

No. 1a size,	"Allday's,"	6 in. outlet,	£18.
No. 1 ,,	,,	7 in. ,,	£19.
No. 2 ,,	"Thwaites,"	8 in. ,,	£20.

with Engines and Boilers to drive.
Address J. LIGHT, Wolverhampton.

ONE No. 3 Roots' Blower and Vertical Engine combined, outlet 8½ in. ; makers, Thwaites.—T. WILLIAMS, Summerfield Place, Neath.

ONE Second-hand Double-spindle MOULDING MACHINE, table 4 ft. 5 in. by 2 ft. 6 in., with two fences, two cutter guards, 20 cutter blocks, countershaft, good as new ; price £17 10s.—WATTS, Canal Street, Nottingham.

25-H.P. Semi-portable Loco-type Compound ENGINE, Robinson and Sons, Ltd., Rochdale, £200 ; Tenoning Machine, Planing and Moulding Machine, same makers, £40 ; each engine can be seen working by appointment.—DAVIES, Highfield, Shirley, near Birmingham.

WANTED, Good Second-hand 5 or 6 ton Geared LADLE.—Send price and particulars to BARFORD & PERKINS, Peterborough.

FOR PLANT & PRODUCTION of English Iron and Steelworks, see Ryland's Directory, the only work which gives complete lists of Iron and Steel-makers, with shapes and sizes of their rolled sections.—Publishers, EAGLAND & CO., LTD., 165, Strand, London, W.C. Price 25s. net.

EXCELLENT WORKS SITES, FOR SMELTING or Chemical Works. Exceptional facilities and privileges. Skilled labour.—Address, REES AND COMPANY, Consulting Engineers, 53, Victoria-street, Westminster, London, S.W.

OFFICES on Ground and Upper Floors, 56, 58, 39 and 47, Victoria Street, S.W. —212A, Shaftesbury Avenue, W.C., near Oxford Street.

BRASSFOUNDER'S BUSINESS FOR SALE as a going concern. Well-arranged Moulding and Finishing Shops, fitted with Modern Plant. Good assortment of Modern Current Patterns. 10 years' lease to run. Rent very moderate. A bargain to an immediate purchaser.—For further particulars apply to Messrs. W. G. & J. W. LINDSAY, C.A., 147, Bath Street ; or to R. A. P. Love, Esq., C.A., 233, St. Vincent Street.

STIGNIC PAINT.
NEWEST AND BEST WASH FOR STEEL FOUNDERS
PLASTIC CUPOLA GANISTER.
FINEST MATERIAL FOR LINING CUPOLAS AND FURNACES AND SETTING FIRE-CLAY BRICKS.
SPECIAL STEEL MOULDERS' COMPO.
STEPHENS & CO., Kidwelly.

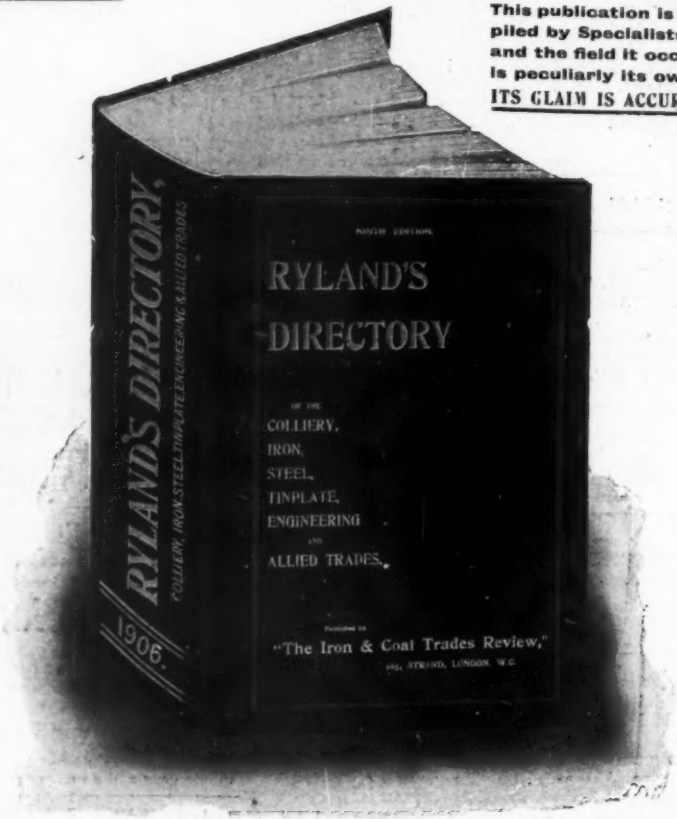
FOUNDRY EQUIPMENT.
PATENT CORE MAKING MACHINES
No linseed oil or flour required.
NEW PORTABLE MOULD DRIERS
Moulds dried on the spot in an hour to one hour and a half.
J. W. & C. J. **PHILLIPS,**
23, COLLEGE HILL, London, E.C.,
And 7, PARK SQUARE, LEEDS.

FIRE BRICKS & CLAY
CUPOLA BRICKS.
BEST QUALITY.
Sole Lessees of Delph and Tintern Abbey Black and White Clay.
KING BROTHERS,
STOURBRIDGE.

LISTS!

HAVE YOU A GOOD LIST OF FOUNDRIES, IRON, STEEL, ENGINEERING WORKS AND COLLIERIES?

This publication is compiled by Specialists, and the field it occupies is peculiarly its own. ITS CLAIM IS ACCURACY.



RYLAND'S DIRECTORY has been the recognised authority for a quarter of a century in the trades to which it appeals.

Its staff is largely composed of Engineers who have either served their time in the shops, or are technically educated. This expert sifting means a great monetary saving to those requiring a directory.

If you are desirous of pushing your business in the Colliery, Iron, Steel, Tinplate and Engineering Trades, either as Producer, Manufacturer, Merchant, Agent, Traveller, etc., it would prove most valuable to you.

NINTH EDITION, 1906,

NOW READY.

Price (Prepaid) 25/- Nett.

CLOTH BOUND.

CUT THIS OUT.

SUBSCRIPTION ORDER FORM.

Enclosed please find.....value 25/- for the 1906 issue of Ryland's Directory.

Name.....

Address .....

.....

CUT THIS OUT.

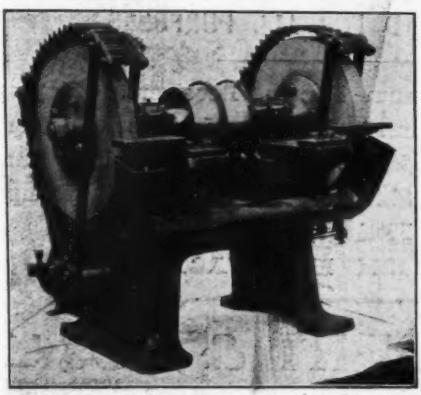
Publishing Offices: **EAGLAND & Co., Ltd., 165, STRAND, London, W.C.**

Telephone No. 47 Heaton Moor.

MANUFACTURERS OF

Telegraphic Address: "Heroic, Reddish."

Crystal Canadian Corundum,



CARBO CORUNDUM

AND

EMERY WHEELS,

For Foundry Use

ALSO

ALL CLASSES OF

GRINDING . . MACHINES. . .

Send for Catalogue and Prices.

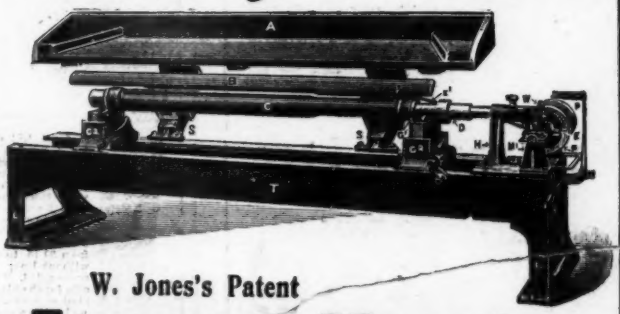
B. R. ROWLAND & CO., LTD.,

REDDISH, Near STOCKPORT.

A REVOLUTION IN

Pipe Foundry Practice

For Pipe Cores, 18 ft. long and 2 in. to 20 in. diameter.



W. Jones's Patent

CORE FORMING MACHINE

JONES & ATTWOOD,

STOURBRIDGE, ENGLAND.

PNEUMATIC PLANT

OF ALL KINDS AND FOR ALL PURPOSES.

Air Compressors, Vacuum Pumps, Receivers, Chipping, Rivetting & Caulking Hammers, Drilling Machines, Grinders, Forges, Hoists, Spraying Machines, Painting Machines, Sand Blasting Machines, Sand Shifters, Air Lift Water Pumps, Hose, Fittings, etc.,

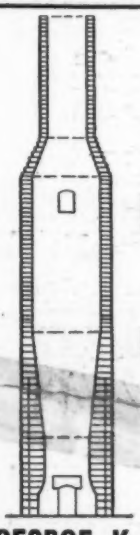
OF BEST BRITISH MANUFACTURE.

LACY-HULBERT & CO., Ld.,

. . . **Pneumatic Engineers,** . . .

91, VICTORIA STREET, LONDON, S.W., and

BOREAS WORKS, BEDDINGTON, Surrey.



Special . .

Quality . .

FIREBRICKS

. for .

CUPOLA

LININGS.

GEORGE K. HARRISON, Ltd.

Fireclay Brick Works,

STOURBRIDGE.

38½"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
32½"

Can also be made in Aluminium.

Telegrams—
"Tuyere, Manchester."

ON ADMIRALTY LIST.

National Telephone—
No. 70, Openshaw.

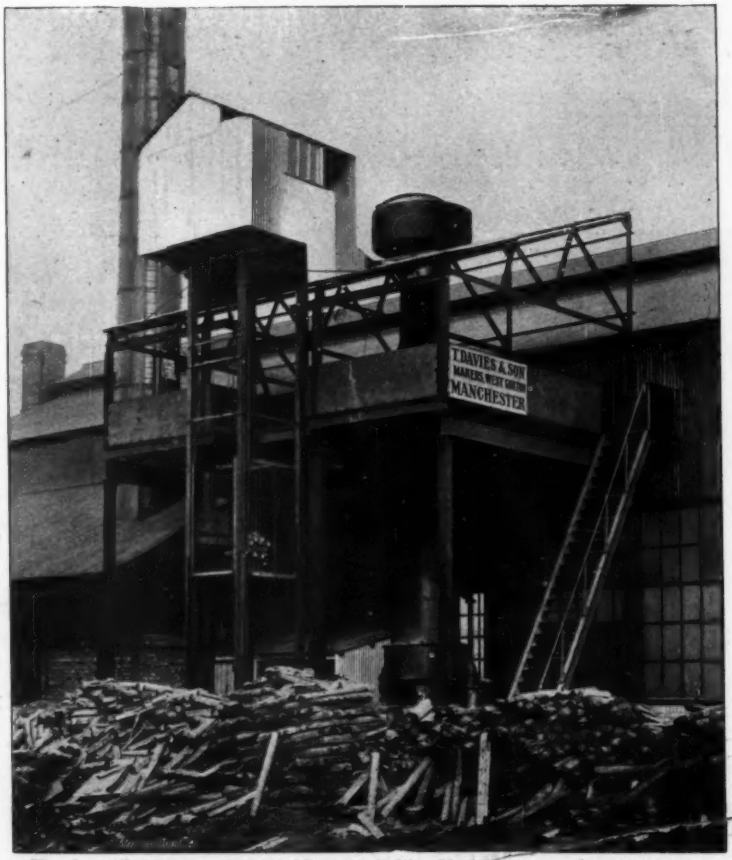
T. DAVIES & SON,

Railway Ironworks,

WEST GORTON, MANCHESTER.

ESTABLISHED 1876.

Agents for London district:—The Simplex Coke Oven and Engineering Co., Ltd., Temple Bar House, London, E.C.



Agents for Scotland:—The Simplex Coke Oven and Engineering Co., Ltd., 144, St. Vincent St., Glasgow.

The above illustration represents a Complete Melting Plant, consisting of Rapid Cupola to melt 5 tons per hour, Charging Platform with a storage capacity of 150 tons, Electrically driven Blower and Hoist.

Speciality:— FOUNDRY CUPOLAS OF ALL TYPES,

UPWARDS OF 500 MADE AND SOLD,

CHARGING PLATFORMS.

COMPLETE MELTING PLANTS SUPPLIED.

FIRST CLASS PATTERN PLATES

are now being made by moulders in foundries, with

WHITE'S PATTERN PLATE APPARATUS

without the aid of any expensive machine tools.

No method of making repetition work in foundries **is complete without** a simple ready system of making pattern plates as required for either hand or machine moulding.

White's system completely meets these requirements. Write for illustrated pamphlet, to

EDW. WHITE, Windsor Works, Redditch.

ON ADMIRALTY LIST. London Office: W. Littleton, 9, Te church Street, E.C.

GROUND GANNISTER, STEEL MOULDERS' COMPOSITIONS, SILICA CEMENT.

Gannister Bricks, Fire Bricks, Stoppers and Nozzles.

Sole Makers of **"PEHRSON'S PATENT STEEL MOULDERS' GREENSAND."**

Crucible Clay for All Purposes.

J. & J. DYSON, Sheffield Gannister Works, ATTERCLIFFE ROAD, **SHEFFIELD.**

Telegrams—"Dyson's, Stannington." Telephone—No. 702 Sheffield.

CHAS. HALL,

Foundry Requisite Maker,

DANTZIC ST., MANCHESTER.

STEEL WIRE BRUSHES.

Chaplets and Studs a Speciality.

COLD BLAST PIG-IRON.

M. & W. GRAZEBROOK,
DUDLEY.

FOUNDRY REQUISITES.

BRUSHES,	CHAPLETS & STUDS,	LADLES,
BELLOWS,	CEMENT,	RIDDLES & SIEVES,
BUCKETS,	CORE GUM,	SPADES, SPRIGS,
BARROWS,	CORE ROPE,	TERRA FLAKE,
BLACKING,	CORE TAPER,	FERRO-ALUMINIUM,
COAL DUST.	CRUCIBLES,	ETC.
	CUPOLAS.	

MOOR & SONS, 1, Fennel St., **MANCHESTER,** (Dept. F.)

Established 1857. Telegrams "Acklam." Telephone, No. 3566.

IMPORTANT TO IRONFOUNDERS.

MOULDING MACHINES

FOR REPETITION FOUNDRY WORK.

ILLUSTRATION . . OF . .

HAND PRESS MACHINE

For Small Repetition Work, Giving Rapid and Economical Production.

MAKERS ALSO . . OF A . .

HAND RAMMING MACHINE.

Where a Deep Lift is Required. Can be Operated by **Unskilled Labour.**

MOST EFFICIENT AND ECONOMICAL IN USE.

ALSO MAKERS OF - - -

ROOTS' "ACME" BLOWERS.

FULL PARTICULARS FROM

SAMUELSON & Co., Ltd., BANBURY, ENGLAND.

SEE OUR ADVERTISEMENT EVERY ALTERNATE MONTH

STOURBRIDGE FIRE BRICKS

OF BEST QUALITY FOR LINING CUPOLAS

— IN STOCK, ALSO MADE TO ANY DESIGN. —

Linings Stocked to Customers' Plans to ensure IMMEDIATE DELIVERY.
All kinds of Fireclay Goods of highest quality.

HARRIS & PEARSON, STOURBRIDGE.

Telegrams: "Fireclay, Stourbridge." Telephone: No. 7 Brierley Hill.

CUPOLA LININGS.

HIGH-CLASS QUALITY

FIRE BRICKS

Made from specially selected clays.

BEST CRUCIBLE CLAYS.

Blast Furnace, Hot Air Stove, Boiler Seating, Flue Cover, and other Best Fire Bricks.

JOHN HALL & CO.,

Of Stourbridge, Ltd.,

STOURBRIDGE.

Patterns

— *and* —

Core Boxes

FRED HIRST,

Phœnix Pattern Works,

HUDDERSFIELD.

ELASTENE CORING ROPES

Are superior to Hay or Straw Bands and are now extensively used in . .

ALL LEADING FOUNDRIES.

Sole Makers—

CITY of LONDON WOOD-WOOL Co.,

Contractors to H.M. Government,

Plover Street, London, N.E.

Charles D. **PHILLIPS'**

Registered and Improved No 356,812

FOUNDRY CORE OVEN

built in wall

Head Office—

Emlyn Works, Newport, Mon.,

(and Gloucester).

Established 29 years.

ON ADMIRALTY, WAR OFFICE, AND INDIA OFFICE LISTS.

SPECIAL BLACKINGS FOR HEAVY ENGINEERING CASTINGS.

BLACKINGS

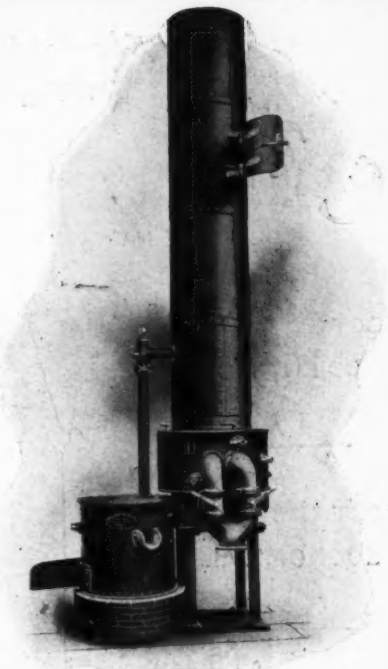
(Iron Moulders).

CARLTON BLACKING FOR STOVE WORK BATHS, etc.

STRAW ROPES and other Foundry Requisites.

THOMAS WILKINSON & CO., LTD., MIDDLESBROUGH.

FOUNDRY PLANT.



Cupolas,
with or without receivers or drop bottoms.

Roots' Blowers,
belt, steam-engine, or electro-motor driven.

Charging Platforms, Hoists, and Ladles.

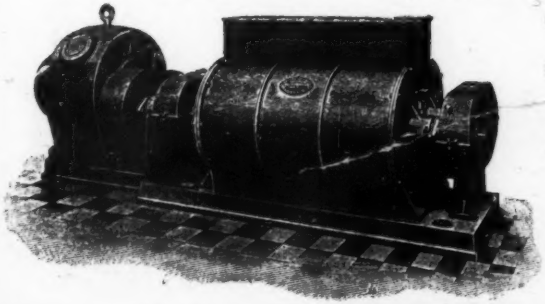
ECONOMICAL RESULTS GUARANTEED.

We are also Manufacturers of Steam Hammers, Smiths' Hearths, Centrifugal Pumps and Fans, High-Speed Engines, and the "Bradford" Patent Boiler Feed Pump.

CONTRACTORS TO HIS MAJESTY'S GOVERNMENT.

THWAITES BROS., LTD.,

Vulcan Ironworks, BRADFORD.



Telegrams —
"THWAITES, BRADFORD."

Telephone:—
No. 325 BRADFORD.

London Office—
96 & 98, Leadenhall Street, E C.

CATALOGUES ON APPLICATION.

Evans' Rapid Cupolas.

ON ADMIRALTY LIST.

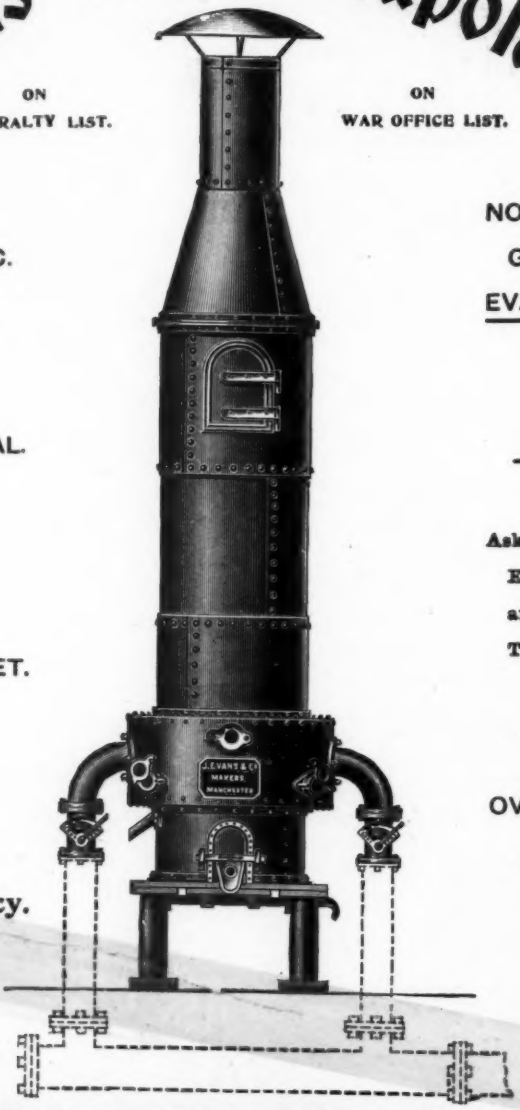
ON WAR OFFICE LIST.

MOST SCIENTIFIC.

MOST ECONOMICAL.

BEST IN THE MARKET.

Highest melting efficiency.



NONE SO GOOD AS EVANS' RAPID.

Ask for Estimates and Copy Testimonials.

OVER 400 IN USE.

Telegrams: "LADLES, MANCHESTER."

Telephone: 2297 Nat., Manchester.

JAMES EVANS & CO.,

Britannia Works, Manchester.